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The
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Vol. XXXI *July to September 1956* *No. 3*

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A. K. YEGNA NARAYAN AIYER

Two years ago when Dr. Coleman landed at the Hindusthan Air Port on a visit to this State after a lapse of 2 decades ours was the unique privilege of seeing all the *Ex*-Directors of Agriculture of Mysore except two, in the same reception enclosure of the Port. Even the two who were absent were fortunately in the land of the living. We should have touched wood when we boasted. After the sad demise of Dr. Coleman in September 1954, death has claimed in rapid succession three of them—Sri. H. V. Krishnayya in 1955, Mr. G. H. Krumbigel in February this year, and Sri. A. K. Yegna Narayan Aiyer on 22nd May.

Rajasevasaktha A. K. Yegna Narayan Aiyer, M.A., Dip. in Agric. (Cantab.), N.D.D., was born on 4-3-1878 in Tinnevelly. After a brilliant educational career in the Presidency College at Madras, he joined the Mysore Department of Agriculture as an Analyst on 3-1-1901. He was granted the coveted Damodardas Scholarship in December 1909 and sent to U.K. where he took the Diploma in Agriculture from the Cambridge University and the National Dairy Diploma of England in a short space of two years. On his return he was promoted as Assistant Chemist in 1911.

For a period of 20 years from 1-3-1914 to 27-2-1934, he was the Deputy Director of Agriculture in Shimoga and at Headquarters. He succeeded Dr. Coleman as Director of Agriculture in 1934 and retired on 4-3-1935.

Sri. Aiyer worked as hard in his retirement as he did in office. He has written more than ten standard works on Agriculture, Dairying and Co-operation, the chief among

them being *Field Crops of India, Principles of Crop Husbandry in India, Chemistry and Manufacture of Dairy Products, Feeds and Fodders, Milk and Milk Products, Co-operation in Indian Agriculture, Village Improvement and Agricultural Extension, Agriculture and Allied Arts in Vedic India.* His books have received appreciative notices from such eminent scientists as Sir John Russell.

Even during his retirement, he served the cause of agriculture in various capacities. He was a President of the Agricultural Section of the Indian Science Congress (1936). He was on special duty with the Indian Council of Agricultural Research and headed several enquiries on its behalf (Clove Cultivation, Mixed Crops, Spices). He made very notable contributions to the progress of Mysore Agriculture as Chairman of the Agricultural Committee of the Mysore Economic Conference.

He was the Founder-Editor of this *Journal* and the *Indian Dairyman* which he edited till 1951.

He had an abiding interest in the Co-operative Movement and served as President of the Mysore Provincial Co-operative Marketing Society. He followed a strict regimen of diet, exercise and work. To the last day of his life he was at work, revising his works or writing new ones or studying the ancient books not for the peace of his soul but to garner valuable information on plants and crops for the benefit of the present and future generations of agricultural students. Verily, he lived, worked and died for the cause of agricultural progress in this country.

A. K. YEGNA NARAYAN AIYER

HANS E. KARDEL

HANS E. KARDEL

We deeply regret to record the sudden and untimely demise of Mr. Hans E. Kardel, Extension Adviser, TCM, Mysore, in June.

Born in Denmark where he spent his boyhood in a dairy farm, he went out to the United States in his youth. He worked as Dairy Herd Improvement Adviser in Michigan and later as County Agricultural Agent for 23 years. It must have been his deep interest in extension work that may have prompted him to give up his home and leisure and come over to India. After a short stay at Delhi he was assigned in May 1952 to the Pilot Extension Project, started a few months before at Malavalli with the generous assistance of the Ford Foundation. Silently and cheerfully he worked among the farmers, sharing their frugal food and toiling for their progress. His abiding interest, his deep understanding and his simple and genuine humaneness won for him their devotion. No foreigner, apart from Dr. Coleman, had so endeared himself to the people of the villages than Kardel *Gowda,* the nickname by which he was lovingly called by them. His work so impressed the authorities of the TCM that he was requested to serve for another term.

He was a genuine gentleman and a real American. We share the grief with Mrs. Kardel and her children.

EDITORIAL

MYSORE AGRICULTURAL SEMINAR

THE Mysore Agricultural and Experimental Union had the unique privilege of conducting the First Agricultural Seminar, possibly the first in India, during the month of May 1956. The idea of holding the Seminar for bringing together on the same platform, the farmers, agricultural workers and policy-makers for discussion of important agricultural problems was as bold as it was novel but not surprising. This Union has always been known for its novel ideas and bold programmes. There are many agricultural unions in India but the Mysore Union is unique in some respects. It is a voluntary body of 5,000 progressive farmers banded together for co-operating with the State Department of Agriculture in conducting field experiments, in holding field days and in disseminating agricultural knowledge through journals of its own, this one and the other, a monthly in Kannada. In arranging the Agricultural Seminar, therefore, the Union has only followed its pioneering traditions built up by the late Dr. L. C. Coleman, its Founder.

When the seminar was first mooted by two farmer-members two years ago, the Union lacked both the funds and the resources for such a venture. Believing as the Union members do, that if a task is worth doing, it is worth doing well, they set about their work in right earnest and within a short period raised over Rs. 18,000 for the Seminar Fund. The Mysore Government, in addition to placing all the facilities available in the Department of Agriculture at the disposal of the Union, gave a generous grant of Rs. 2,000 and sanctioned the printing of the Seminar Report* free of cost at the Government Press.

Along with the collection of funds, the Union set up a number of committees for preparation and issue of questionnaires, nearly 4,000 of which were sent out to farmers, workers and specialists, leaders and legislators in the State and to some outside. The replies were processed to serve as the bases for discussion during the Seminar.

The Seminar was inaugurated in a tastefully decorated *shamiana* (marquee) on the campus of the Agricultural College at Hebbal on 12th May 1956, by the Union Minister of

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* A full report of the Seminar is under compilation and will be printed shortly.

Agriculture, Dr. Panjabrao S. Deshmukh, under the Presidentship of Sri. K. Hanumanthaiya, Chief Minister of Mysore. It divided itself into 6 groups for study and discussion of the following subjects :—

1. Agricultural Education including Agricultural Extension and Youth Clubs.
2. Horticulture and Home Science.
3. Agricultural Research.
4. Agricultural Supplies and Services; Agricultural Economics.
5. Livestock Improvement and Mixed Farming.
6. Agricultural Legislation.

The reports of these committees were presented to the plenary session of the Seminar for adoption on 15th May.

As adjuncts to the Seminar, one of the biggest, if not the biggest agricultural exhibition was organised. Every evening, lectures by ministers and legislators, and symposia by workers and specialists were arranged. Each day was rounded off with music or dance, drama or films.

The Seminar concluded on the 16th with a stirring address by Dr. M. Channa Reddy, Minister of Agriculture, Hyderabad State.

The Director of the Seminar and Director of Agriculture, Sri. M. Mallaraj Urs, the Deputy Director of the Seminar and Vice-President of the Union, Sri. V. Masiyappa; the Chairman of the Seminar Committee and Deputy Director of Agriculture, Dr. B. Dasappa; Sri. M. Vasudeva Murthy, till recently the Secretary of the Union; the Union Managing Committee, and the enthusiastic staff of the Department both at Headquarters and in the districts who spared no pains and toiled ceaselessly to make the Seminar a fruitful and memorable occasion are to be congratulated on their unique achievement.

Original Articles

INDUSTRIES BASED ON OILSEEDS

By Dr. P. J. Gregory[1]

India occupies an enviable position with regard to the production of the various kinds of oilseeds which play an important part in her industrial economy. Groundnut, rape and mustard, sesamum, linseed, castor, cotton-seed and copra are the most important oilseeds which are systematically cultivated and produced in India. The following figures show the production of different varieties of major oilseeds in India as compared to that of the world :

in thousand tons

	Indian production in 1953	World production in 1953	Indian production as percentage of World production
Groundnut ..	3,573	10,889	32·8
Cotton-seed ..	1,377	15,121	9·1
Rape and mustard ..	826	4,764	17·3
Sesamum ..	531	1,931	27·5
Linseed ..	355	3,035	11·7
Copra ..	190	2,691	7·1
Castor seed ..	107	452	23·7
Total ..	6,959	38,883	17·09

Consequently, India is a larger producer of vegetable oils which form not only important articles of food but also essential raw materials for industries such as soaps, paints and varnishes, vanaspati, lubricants, etc. Each oil has got its own special characteristics and none is equally suited for all purposes.

Manufacture of vegetable oil has been practised in India from time immemorial as a sort of cottage industry with the aid of indigenous appliances such as bullock-driven *ghanis*.[2]

[1] Secretary, Indian Central Oilseeds Committee, Hyderabad; now Secretary, Indian Central Coconut Committee, Ernakulam.

[2] Country oil mill.

With the growing industrialisation of the country after the First World War, large-scale crushing of oilseeds with modern appliances has come to stay, as a result of which, the bulk of the oilseeds produced in the country is crushed within the country itself. Remarkable expansion in the oil-crushing industry has taken place since the Second World War. It is estimated that during the triennium ending 1950-51, out of the total production of each of the oilseeds in India, 76% of groundnut, 75% of sesamum, 69% of castor seed, 89% of the rape and mustard and 75% of linseed are used for oil extraction. Some rough estimates regarding the quantity of major oilseeds crushed by power mills and bullock-driven *ghanis* shown below will bring out the importance of oil extraction by village *ghanis* as a rural industry.

in thousand tons

	Power Mills	Village *ghanis*
Groundnut ..	1,200	568
Rape and Mustard ..	500	197
Sesamum ..	22	246
Linseed ..	260	25
Castor seed ..	50	..
	2,032	1,036

The oilseed-crushing industry in India is offering employment to her teeming millions. The number of oilseed-crushing establishments is on the increase every year. According to the latest available information, it is found that 1,123 large-scale mills with a productive capital of Rupees 33 crores and employing more than 47,000 persons were engaged in the production of vegetable oils. In addition to the mills given above, it is estimated that more than 6,000 smaller power mills and about 4·5 lakhs village *ghanis* distributed all over the country are also engaged in oil extraction. The village *ghanis* by themselves are estimated to account for a crushing capacity of about 13 lakh tons of oilseeds.

Manufacture of soap which has come to stay as an essential article in the daily life of modern man is dependent on vegetable oils. India is manufacturing high class soaps of all varieties.

According to the census of manufactures, it is found that 10,478 tons of hydrogenated oil and 29,975 tons of vegetable oils were used in 1950 for the production of 69,069 tons of soaps of all varieties worth Rupees 13 crores in 61 major soap factories in India. Taking into consideration a large number of small-scale and cottage units engaged in the industry, the total production of soap will be of the order of 100,000 tons. Indian soaps had very good export markets during the later years of the last war in Indonesia, Malaya, Ceylon and Pakistan and if the prices of soap are kept low, Indian soap will certainly continue to bring us foreign currency.

Another important industry in which vegetable oils form an essential raw material is the manufacture of paints and varnishes. The industry is of recent origin in India. The first paint factory in India was started in 1902 and the second one in 1922. Since then, many other factories have come into existence. Paints and allied products of the value of more than Rupees 6 crores are produced in 44 major factories of India. The actual number of factories may be much more. It is estimated that about 45,000 tons of linseed oil is used annually in the manufacture of paints and varnishes. Since this is a highly specialised industry requiring technical supervision of a high order, it was in the hands of Europeans till very recently. The chief centres of the industry at present are Calcutta and Bombay.

The production of vanaspati or hydrogenated vegetable oil is another industry based on vegetable oils. It is the second largest food-processing industry in India—the first being sugar industry. Nearly Rupees 25 crores have been invested in this industry which provides employment to about 75,000 persons. At present there exist 48 factories with annual productive capacity of 335,000 tons.

Vanaspati is a simple vegetable oil which is refined and hydrogenated to make it more palatable. It is used as a sort of cheap substitute for *ghee*[3] by most of the people. Usually vanaspati contains 95% of groundnut oil and 5% of *til*[4] oil. Because of the high price of groundnut oil, refined cotton-seed oil is also used now-a-days in place of groundnut oil.

The following figures will speak for themselves the popularity and increased demand of vanaspati as years pass by :

[3] Clarified butter.

[4] Sesamum.

in thousand tons

	Production of Vanaspati	Consumption of raw materials
1938	44·4	44·0
1947	95·1	132·0
1948	129·7	153·0
1949	155·6	195·0
1950	171·6	191·7
1951	172·3	219·6
1952	190·8	227·8
1953	191·6	227·9
1954	229·1	259·2

Lastly, the uses of vegetable oils in the manufacture of lubricants, toilets and medicines are no less important. It is estimated that about 20,000 tons of castor oil, 16,000 tons of sesamum oil and 2,000 tons of rape and mustard oil, in addition to a substantial quantity of coconut oil, are used in these industries.

(Received : 19th December 1955)

STATUS OF *HELIOTHES ARMIGERA* Hb. AS A PEST OF *CANNABIS SATIVA* (*GANJA*)

By Dr. M. Puttarudriah[1] and M. Appanna[2]

Heliothes armigera Hb. (Lepidoptera, Noctuidæ) is almost an ubiquitous insect, being present in Europe, Asia, U.S.S.R., Africa, Australasia and Pacific Islands; North, Central and South America, and West Indies.

This insect is polyphagous, having a large variety of food plants. Essig (1947) has recorded 29 host plants in addition to the three important ones—cotton, corn and tobacco. It is popularly called in the United States as American cotton bollworm; corn earworm and tomato fruitworm, mainly depending on the crop it attacks. In India, this insect is called "Gram Caterpillar" on account of its causing severe damage to Bengalgram. It is recorded to attack cotton, tobacco, cabbage *Cicer arietinum*, *Cannabis sativa* (*Ganja*), *Dolichos* and other hosts. It has also been observed recently on *jola* earheads. The actual damage to this crop is yet to be assessed.

Cannabis sativa (*Ganja*) is a protected crop in Mysore State, the crop being grown under special permission and supervision of Government. This crop was usually grown only in Goribidanur Taluk and in 1954-55, its cultivation was extended to Manchenahalli Tract in Chickballapur Taluk.

Heliothes armigera Hb. has appeared in the *Ganja* fields every time the crop was grown in Goribidanur area and during the year 1954-55 it made its appearance not only in the old areas but also in the new tracts where the crop was grown for the first time. Thus it can be said that *Heliothes armigera* is an endemic pest on *Ganja*.

The appearance of this insect in all the *Ganja* fields in fairly large numbers caused anxiety to both the cultivators and the Government authorities. This necessitated a close inspection of all the *Ganja* fields to study the presence of the insect and its influence on the crop.

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[1] Govt. Entomologist.

[2] Senior Assistant Entomologist, Division of Entomology, Mysore State Department of Agriculture.

Heliothes armigera Hb. Caterpillars on Spikes of *Cannabis sativa* (*Ganja*)

[*Photo by P. R. Raghuram*]

Experienced cultivators opined that this insect invariably made its presence whenever *Ganja* was grown but they had not seen the insect in such large numbers as in 1954-55 ; and that they were not mindful of the occurrence of the insect in previous seasons, when the insect was found in small numbers.

The observations made during 1954-55 revealed (1) that the insect was prevalent in all *Ganja* fields on the crop at the time of spike formation though the insect was seen in small numbers on young plants, (2) that the damage to leaves was not commensurate with the number of caterpillars present on the crop, (3) that the insect was present in good numbers on or near the spikes (*Kudis* or *Kallis*) and that some of the seeds were found chaffy in only a small number of spikes due to the feeding by the insect, (4) that a number of dried up spikes was found beneath some plants in patches and this was attributed to the damage by the insect in cutting them.

From a detailed survey of all the areas, it was found that the insect, though present in large numbers, did not do so much damage to the crop as to reduce the yield appreciably. The presence of large numbers of the insect was the main cause for the anxiety on the part of the cultivators.

Control of this insect is faced with certain practical difficulties. Being a narcotic plant, use of chemicals would adversely affect the utility of such treated plants for ready consumption. Hence the mechanical method of control—handpicking of caterpillars, seems to be the only method that could be employed to control the insect. But it is just possible that insecticides can only be used on the caterpillar when they are seen at an early age of the crop.

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(Received : 23rd March 1956)

WATER AND CROP PRODUCTION

By H. G. Gopala Rao[1] and Dr. S. V. Govindarajan[1]

Water is an essential constituent of all plants and as such it is recognised to play a vital role in crop production. Over a greater part of this country water-supply is a limiting factor in improving crop production and wherever these supplies can be controlled in the agricultural tracts of the country, their equitable distribution has become one of the major activities of the administration. A proper understandnig of the basic principles of water utilisation for crop production by farmers, agricultural officers, irrigation engineers and revenue officers who are all concerned with the water-supply and its utilisation for agricultural purposes will be of advantage to the country as a whole. Such understanding will help in the proper utilization of available water and prevent wastage and avoid misuse of water with their attendant evils. Improper use of water on land could lead to development of harmful conditions like salinity, alkalinity, waterlogging and permanent deterioration of soil structure, all of which tend to affect desirable properties in soils and reduce crop production.

Water is one of the major constituents of all living plant materials. Vegetables like cabbage and lettuce contain upto 95% and forage crops usually contain 75-80% water while fresh grains like paddy and wheat upto 10%. Important biological and chemical reactions in the plant body and in the soil take place in an aqueous medium. Plants wilt permanently and die once the level of water content in the plant body goes down below a certain minimum. The nutrient matters from the soil enter the plant body in aqueous solutions. Water regulates the plant temperature through a process known as 'transpiration' which helps in keeping the plant cool by giving off water freely in the manner of animals "sweating" during hot days. Thus to keep going all the above activities inside and outside the plant, a continuous supply of good water is a primary prerequisite.

The quantity of water needed by each type of plant is variable. A crop like paddy needs enormous quantities of standing water during its growing period while *ragi* and similar dry crops

[1] Division of Agricultural Chemistry, Department of Agriculture, Bangalore.

can do with much smaller quantities of moisture and vegetable crops come midway between the two extremes. A new technical term has come into popular usage designated the "Water Requirement" which indicates the relative water needs of each type of crop. Suitable laboratory and field methods are now available to determine under controlled conditions the water requirements of any crop.[1,4–6]

The water requirement of the crop in the field is however a variable quantity depending upon various factors like topography, nature of soil, fertilizers used, cultural methods, atmospheric and climatic conditions. When the soil, for example, is loose and sandy, more water is needed since water losses are high, whereas a heavy clay soil holds moisture and the water needs are more easily met. Similarly, crops growing in arid regions need more water than in humid regions because surface evaporation is high in the former case. It has also been shown by field experiments that the water requirement of crops is enhanced in proportion to the fertilizers used on the field. In a general way, the more vigorous the growth of plant, the greater is the need for water.

For clear appreciation of the water needs of a crop for any particular area, it is best to determine the "Water Balance". The main sources of water for a crop are naturally from atmospheric precipitations like rain, dew or mist. Not only is the total yearly rainfall important for raising successful crops but also the distribution of rainfall during the growth period of the crop. This latter factor is of particular importance because of the differing needs for moisture at the different stages of growth of the plant like seedling stage and flowering stage. The requirements for water at these stages in the case of cereals and legumes is usually more than at other periods of growth. The precipitation that is received during the period of crop growth is lost from the ground due to surface evaporation, subsurface percolation and transpiration from the leaves of the growing crop. The total water requirements of a crop during its growth period is determined as a sum of the above three factors of moisture losses. This can be represented by the equation:

Total water requirements of a crop = evaporation of moisture from the field + percolation losses in the field during the growth period + the transpiration requirements of the crop.

Suitable methods are available for determining these values at every locality so that the total water requirements of each

crop can be computed with an amount of accuracy. Against the total water requirements of a crop is to be balanced the precipitation during the season.

If the balance is favourable as computed from data over a long period, there is no need for extra irrigation water and satisfactory crops can be ensured. If, on the other hand, the atmospheric precipitation is not enough, recourse has to be had to irrigation. This irrigation may be intermittent or continuous depending upon the climatic conditions of cropping, nature of soil and water availability. For a fully irrigated crop like paddy, the irrigation requirements are calculated from the equation. Gross irrigation requirements = net irrigation requirement (*i.e.*, total water requirements − precipitation during season) + water distribution losses.[2]

The gross irrigation requirements of a crop is usually designated by the term "Duty of Water". This term is taken to indicate either the quantity of water required to raise the crop over a unit area or else the extent over which the particular crop can be successfully raised with a specified rate (one cusec) of flow of water. The total water required for our common crops as designated by Duty of Water, have been found to be 40 for paddy, 40 for sugarcane and 120 to 150 for semi-dry crops.[7]

In a properly integrated scheme of land and water utilisation, full information and particulars on the water requirements of each of the crops of the area should be freely available to all. This would educate the *ryots* to make intelligent use of the water, and would help to remove the widely divergent opinion now prevailing between the agriculturist on the one hand, who is mainly concerned with the maximum yield of his crop regardless of the amount of water used in the process and the irrigation authorities who are primarily engaged in distributing the quantum of water to be made available for satisfactory cropping on the basis of Duty of Water. Such understanding of the principles of irrigation of crops would prevent misuse of water, deterioration of soils and the various attendant disadvantages which effect the health and economy of the agricultural community.

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(Received : 9th December 1955)

NOTES ON THE PRELIMINARY EXPERIMENTS WITH WEEDICIDES—II

By Dr. M. Puttarudriah[1]

Since the writer reported the indicative results of some experiments with several selective weedicides on many dicot weeds growing in waste land and rice fields, it became necessary as part of general plant protection work to test some weedicides on particular weeds like the nut grass, *Cyperus rotundus* L.; the wild garlic, *Oxalis corniculata* L.; and the Bahama grass, (*Hariyali*), *Cynodon dactylon* Pers., as removal of these weeds was very difficult and expensive by mechanical methods.

Cyperus rotundus L. (Nut Grass) ಕೊನ್ನಾರಿ (ತುಂಗೆ ಹುಲ್ಲು)

This is deep-rooted with a number of bulbs at frequent distances on the root. Even if the plant is killed, the bulbs go on sprouting. It is a very common and major weed, very difficult to control, in garden plots.

Six plots, each $3' \times 3'$, were laid out and the nut grass was planted 300 in number in each of the plots, and was allowed to establish itself very well. After a good and uniform stand of 'grass' was got, five of the plots were treated each with a different type of weedicide and the sixth plot served as untreated control. Weedicides used were 4 selective weed-killers—Kathon M. 7, Phenoxylon, Hedonal powder, Crag and one general weed-killer—Tributon.

Kathon M 7, manufactured by Rohm and Haas Company, Philadelphia, U.S.A., contains 49·8% of the dimethylamine salt of 2, 4-dichlorophenoxyacetic acid (equivalent to 41·5%, 2, 4-D) was sprayed in the proportion of 2 pints in 20 gallons of water per acre. It is brownish liquid ; mixes well with water and has an unpleasant acetic acid smell. The sample was supplied by M/s. Amritlal & Co., Bombay.

Phenoxylon manufactured by Pest Control, Ltd., of Cambridge, England, contains as active ingredients the sodium salts of methylchlor-phenoxyacetic acid (MCPA) and was sprayed

[1] Government Entomologist, Mysore State Department of Agriculture, Bangalore.

in the ratio of 1/3 gallon in 100 gallons of water per acre. It is a reddish liquid, mixes well with water and has a strong repellent smell. Sample was supplied by Parry & Co., Madras.

Hedonal powder, manufactured by Farbenfabriken Bayer, Liverkusen, Germany, is the sodium salt of 2, 4-D acid. It is an odourless white powder, dissolves completely in water without leaving any residue. It is a spraying powder and was used in the proportion of 2·2 lb. per 2·47 acres. Sample was supplied by Messrs. Chika Ltd., Bombay.

Crag, manufactured by Carbide and Carbon Chemicals Company, New York, U.S.A., is sodium 2, 4-dichloro-phenoxy ethyl sulphate, a white powder, dissolves completely in water ; but it is better to dissolve it in a little quantity of water by stirring and then diluted. It was sprayed in the ratio of 1·0 oz. per gallon of water. Sample was supplied by National Carbon Co. (India), Ltd., Calcutta.

Tributon, of Farbenfabriken Bayer Co., Germany, is a general weedicide based on 2, 4-D and 2, 4, 5-T esters, is a brownish liquid, mixes completely with water and has a strong repellent smell. It was used in the ratio of about 15 c.c. per gallon of water. Sample was supplied by Chika Co., Ltd., Bombay.

Required quantities of these several weedicides in the respective proportion, were prepared and sprayed on the standing nut grass in the experimental plots, except in the case of Crag, where the nut grass was cut to soil level as instructed by the firm and the solution was sprayed. In all cases a water can was used in treatment to prevent spray drift, and about half-a-gallon of the solution was required per plot.

Observations

In all cases of treatment except Crag, yellowing of blades commenced in about a week and the plants were completely dried up in 20 days ; though it took a few more days in the case of Tributon. After a month-and-a-half, 8 plants in Tributon-treated plot and 2 in Phenoxylon and none in Hedonal and Kathon were growing. After 2½ months there were 46 plants growing in Tributon plot and only 2 plants in Phenoxylon and Hedonal plots, and none in Kathon plot.

In the case of Crag, the cut ends were seen growing on the fourth day and there were 50 plants after a week and 80 plants

after 2 weeks though some of them appeared sick. They began to decline in growth, turning yellow after 3 weeks from the date of treatment and after a month-and-a-half, 40 plants had declined completely and 40 were coming up well. But after 2½ months, there were 172 plants in the plot all growing luxuriantly. At this time, a second treatment with CRAG at 1·0 oz. per gallon of water was given to the plot; but after 3 days, the plants were seen sprouting, and at the third month, many plants had grown up well. At the fifth month, there were 254 plants, which worked up to 83·3% sprouting.

In other plots, many plants had grown up in TRIBUTON and there could be relief for nearly 4 months; though a few negligible number of plants had grown. No growth of *Cyperus* was seen in KATHON and only three plants seen in PHENOXYLON. At the fifth month, conditions remained the same in KATHON and PHENOXYLON plots but in TRIBUTON and HEDONAL powder plots there were 129 and 50 plants respectively (42% and 16·6%). So KATHON and PHENOXYLON appear to be the best against this weed, and HEDONAL powder ranked third in the series; but the dosages on an acre basis have to be tried and results watched.

In another series of 3 plots each 3′ by 3′, TRIBUTON and CRAG were tried at double the formulations, namely, 30 c.c. of TRIBUTON per gallon and 1·5 oz. of CRAG per gallon of water respectively and HEDONAL powder at the same strength adopting the same method of treatment in all cases.

In the case of TRIBUTON all the plants were completely dried up in 3 weeks and about 6 plants were seen growing at the fourth month. In the case of CRAG, the higher formulation was found to be very effective in that, though sprouting was seen next day, they declined in about 10 days and no plants were seen even after 4 months. HEDONAL powder-treated plants turned yellow in a week and all dried up in 2 weeks, and results of previous plot could be confirmed.

Another plot of 3′ × 3′ of this weed was treated with MH-40 (MALEIC HYDRAZIDE) manufactured by Naugatuck Chemical International, New York, U.S.A. and sample supplied by Bombay Chemicals, Ltd., Bombay. It is a white powder which readily dissolves in water; and was used at the rate of 10 lb. in 50 gallons of water per acre. Water can was used for treating the plants. No difference could be seen for about a week in the condition of the weed, when as required by the firm, the

weed was dug up and mulched into the soil of the plot. There were no plants sprouting for nearly 4 months when half-a-dozen plants had come up and became bushy and stunted. The same condition was observed even after 4½ months with 6 more plants seen, but the number was negligible.

Cynodon dactylon Pers. (*Hariyali*) ಗರಿಕೆ

Hariyali is a perennial weed interfering with cultivation of crops in any area and particularly bad in parts of Chitaldrug district like Jagalur and Holalkere taluks. Two plots 4′ × 6′ full of naturally grown grass were selected and sprayed with MH-40, and Tributon respectively by means of a water can.

Observations

In the case of MH-40, the dosage rate and method of treatment were similar as in the case of nut grass, the plot being dug up after a week from date of treatment and the grass mulched in. Observations on this grass were exactly similar as in the other case, the grass seen gradually growing at the margins of the plot after about 4 months and this condition remaining even after 4½ months.

Tributon at 30 c.c. per gallon of water was used on this grass and was left without being mulched in. The grass began to turn yellow gradually and dried and observations in this case were very similar as in MH-40, but later this plot was interfered with and was given up. Observations in MH-40-treated plot are being continued.

Oxalis corniculata L. (Wild Garlic) ಕಾಡುಬೆಳ್ಳುಳ್ಳಿ ಸೊಪ್ಪು (ಪುಳ್ಳಂಪುರ್ಚಿ)

This again is a troublesome weed in vegetable plots, with underground bulbs, each bulb having many cloves each of which can sprout into a separate plant. Cultivators have been finding it very difficult to control it.

Seven different samples of weedicides were tested on this weed, each in a plot of 3′ × 3′, with an untreated control plot. The 5 weedicides, namely, Kathon M 7, Phenoxylon, Hedonal powder, Crag (all selective) and Tributon (general) together with two more selective weedicides—Fernoxone and Agroxone were tried on this weed.

The information regarding the source of the five weedicides and their formulations given on the experiments with nut grass,

holds good even here also as the same concentration and dosage rates were tried.

FERNOXONE is a 80% sodium salt of 2, 4-D and a white powder, which can be applied as a spray by dissolving it in water. It was sprayed at a dosage rate of 1¼ lb. in 100 gallons of water per acre. It is manufactured and sample supplied by Imperial Chemical Industries (India), Ltd., Madras.

AGROXONE 5% dust is methyl chlorophenoxy acetic acid containing 5% active material. It is a product of the above firm, and is a white powder, ready to use. It was tried by dusting 5% AGROXONE at the rate of 200 lb. per acre.

OBSERVATIONS

AGROXONE had no effect on this weed even for 4 months and so was given up.

In the case of FERNOXONE spray, yellowing of leaves with contorted, elongated stems was seen after a week and all the plants were killed in about 12 days from the date of treatment. After a relief for 7 weeks, a few plants were seen sprouting and very soon, the plot was full of plants. After 4 months, the plot was discarded.

In the case of CRAG, sprayed at 1·0 oz., in 1 gallon water after cutting the plants to soil level, plants began sprouting after 5 days and there was no effect on the sprouting bulbs. After a month a second treatment with the same concentration was given to this plot after cutting again the plants to soil level. After a month and ten days, a few plants sprouted and by about 2½ months, many had grown and the plot was discarded.

PHENOXYLON when sprayed at 9 c.c. in 1 gallon of water showed slight fading, and yellowing on the second day but the plants were not completely killed even after 7 weeks. A second treatment after 2 months and 10 days, and a third treatment after a month and 9 days from second treatment did not show any difference from the first treatment. The experiment was given up. This weedicide at double the concentration, 18 c.c. in 1 gallon of water was sprayed on another plot; and 3 treatments with a month's interval each time, were given, but the effect was no better; PHENOXYLON did not give the desired results on this weed.

KATHON M 7 was as ineffective on this weed as PHENOXYLON even with 3 treatments with an interval of a month, though

drooping, scorching of leaves with elongated stems were observed 24 hours after treatment. Plants came up in about a month.

HEDONAL powder proved to be better and more effective on this weed even with one treatment only. Yellowing and drooping commenced on the next day after treatment and all the plants were dead in 1 week. Though half-a-dozen sickly looking plants were seen coming up after a month-and-a-half, there was a good relief for nearly 3 months, by which time some more plants had grown.

The general weedicide, TRIBUTON, scorched the plants and many were killed in about 4 days, but the relief was only for about a month, by which time many had sprouted. The same result could be seen with two more treatments with an interval of a month. With double the dosage of this weedicide, no better results could be achieved except that the plants were burnt up within 2 days and the relief could be for 1½ months only.

CONCLUSIONS

These experiments have shown that KATHON M 7, PHENOXYLON and HEDONAL powder were effective on nut grass and are mentioned here in the order of their merit. MH-40 has also given promising results.

On *Hariyali,* both MH-40 and TRIBUTON are promising.

HEDONAL powder proved to be better than the other weedicides, in killing the wild garlic weed.

But as mentioned in the case of nut grass, the promising weedicides on the different weeds have to be tested on acre basis, before definite recommendations can be made. These tests and observations are being pursued.

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MINERALS IN ANIMAL NUTRITION

By H. S. Lakke Gowda[1]

Minerals play a valuable and a very important part in the nutrition of animals as well as of human beings. It is this aspect of the problem, that attracted the attention of many workers, all over the globe. Minerals assumed great prominence in the field of nutrition and increased importance is being given to this branch of study during the past decade or two. Much work has been done in this branch, and still much remains to be explored. The subject of mineral deficiency in the diet of cattle and other farm animals, is also studied by many Indian workers also. Though there are not much evidences, in the case of farm animals, of widespread incidence of actual diseases due to mineral deficiency, still there is no doubt that lack of certain essential minerals has a significant influence on the health and development of our livestock, occurring in subclinical form. Deficiency in one or more minerals brings about the deterioration of physical condition, which in turn, induce low production, susceptibility to diseases and high mortality. Continued feeding of deficient ration to our cattle, which are already under continued malnutrition, is mainly responsible for the present plight of our livestock industry.

Some of the essential minerals are found in abundance both in the body of the animals as well as in plants. Calcium, phosphorus, sodium, potassium, magnesium, iron, sulphur, chlorine and iodine are some of the most essential minerals found in abundance. Copper, cobalt, manganese, zinc, nickel, boron, molybdenum, selenium and fluorine are some of the minerals found in traces, hence they are called as 'trace elements'. Some of these are toxic and some are nutritious trace elements.

It is found by experiments, that each one of these elements is essential to the health and well-being of farm animals. But all elements have not been tested with all species. It is more probable that all higher animals require all these elements. There may be still more elements which perform essential functions and which are not yet investigated. Many of them are

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found in the body of the animals mainly because they are present in the vegetable kingdom and may or may not be playing any valuable role. Some of the elements which are found to be essential may also be harmful, if provided in excess. Even small quantities of copper and iodine, which are found to be highly nutritious, are found to be toxic in large amounts. Though selenium and molybdenum have no known functions to perform, still they are found in some places in toxic quantities among natural feeds.

Calcium and Phosphorus.—Calcium and phosphorus are found to be the most important of all the minerals required for animals. These two elements are very important for the development and for proper maintenance of normal health, growth and appearance. Insufficiency of these two minerals leads to abnormal and poor skeletal growth (*i.e.*, bone and teeth formation), late maturity, lowered fertility, reduced milk yield, etc. There will be general unthriftiness, resulting in depraved appetite (licking walls and eating filth) and stunted growth. All growing and lactating animals have greater need of these two minerals. Hence the need for more calcium and phosphorus for this class of animals and generous supply of good mineral mixture for lactating and growing animals is an absolute necessity for proper production and development.

Magnesium.—The diseases called 'grass tetany', 'magnesium tetany' or 'grass stagers' which are characterised by their vasodilatation, hyper irritability, convulsion and death are all attributed to magnesium deficiency. The animals effected by this disease, respond to the treatment of magnesium. Magnesium activates the enzyme phosphatase and plays a valuable role in carbohydrate metabolism. But all common feeds contain sufficient amount of magnesium, hence no necessity to supplement the feeds with this element.

Iron.—As an essential constituent of the respiratory pigment, hæmoglobin, iron is essential for the functioning of every organ and tissue of the body. Iron deficiency anæmia may occur at any time of life when the available supply of the mineral becomes deficient, relative to the needs for hæmoglobin formation. The amount of iron supplied to the suckling depends upon the store of its mother. If the diet of the mother during the period of gestation is very low in iron, then the new-born will not be having sufficient iron to utilise it in its later development. Anæmia can be prevented by the feeding of iron and

a trace of copper to the diseased. Almost all foods contain sufficient amount of iron and all seeds and cereals and particularly the outer coverings contain enough of iron to ensure against iron deficiency, in the case of farm animals.

Sodium and Potassium.—Other mineral elements such as sodium and potassium have also vital functions to perform. They are mainly concerned in the regulation of metabolism and growth, but they are invariably present in all foodstuffs and hence their sufficiency is assured. In view of the fact that potassium is always present in abundance in vegetable kingdom, lot of sodium is also required for the proper maintenance of the balance between the two. Because of the fact that more sodium is eliminated when more potassium is eliminated, thus causing a deficiency of sodium, without causing the deficiency of potassium which is already present in excess, sodium is always added to the diet of all classes of animals.

Sodium and potassium are required for the normal activity of the heart and for the development and proper functioning of all the cells. Potassium influences the heart-beat regulations. Sodium functions in all acid-base balances, osmosis and in all other physiological functions of the body. Adding to it chlorine in the form of sodium chloride, is necessary for the secretion of hydrochloric acid in gastric juice.

Trace Elements.—The term "trace elements" refers to any element which commonly occur in minute amounts in living tissues, whether it is known to exercise any useful functions or not. It is usually a tendency to assume a purpose for an element if it is found to be locally concentrated in some particular tissue, as in the case of iodine in thyroid gland and iron in red blood corpuscles. During the process of absorption of major essential minerals from the soil, the plant incidentally takes up traces of numerous other elements merely because they are present in the soil irrespective of their functions. Some of these elements are expected to be inert and some others are beneficial. Any trace element present in the plant, naturally find its way into the animal tissues but it may be long before it is recognised as essential, beneficial, harmful or entirely inert. However, it is very difficult to assess the significance of any trace element, due to the fact that physiological functions may be quite different in plants and animals and also the quantities present may have a very different significance for different forms of life.

The elements copper, cobalt, manganese, zinc and boron are considered to be nutritive trace elements and are concerned with the deficiency diseases ; fluorine, selenium and molybdenum are considered to be toxic trace elements and are concerned in chronic intoxication. Other trace elements like aluminium, nickel, lead and arsenic are not found to be biologically essential and are found to contain in non-toxic levels in plants, hence not absorbed through plant roots, in quantities injurious to animals. They may be present in other foods in harmful amounts only as contaminants, but the amount of aluminium and nickel which are also toxic, is too high to occasion alarm, while the dangers of contaminant arsenic and lead are too well known to call for comment.

Copper.—The occurrence of copper in plants and animal tissues has been recognised for over a century but it is only during the last decade that its importance had been conclusively established. Associated with the copper deficiency, the disease called in cattle "Lecksucht", characterised by cachexia and pica is very common. Fertilisation of the soil with copper sulphate rectifies the deficiency of the soil, the plants and finally the animals (14 lb. of copper sulphate per acre is sufficient for the purpose). Deficiency in animals can be controlled by oral administration of soluble copper salt ($CuSO_4$). The so-called "falling disease" of cattle in West Australia, characterised by cachexia, anæmia, suppression of œstrus in cows and stunted abnormal growth in calves, is regarded as a simple copper deficiency. In mild form of the deficiency of copper, sheep generally produce steely wool and loss of general crimp from the wool. Running down in condition, unthriftiness and anæmia are also common to this disease. Black sheep eventually produce steely wool containing no pigment. Ataxia and the inco-ordination of the hind limbs and occasional blindness, in the newborn lambs of the deficient ewes, are the distinct features of copper deficiency. Affected lambs which are generally one or two months old, first show unthriftiness, a check in the growth rate and stiffness of the hind legs when driven. As the disease progresses, there is excessive flexion, knuckling over and wobbling of the hind quarters and eventually the lamb falls over and is permanently unable to rise. Copper deficiency in cattle brings out the damage to the heart and the stresses and strains of pregnancy, lactation and growth precipitates death from heart failure. Affected animals will generally have rough coat and

suddenly fall down and may die instantaneously or struggle for some time before death.

Cobalt.—"Coast disease" of sheep in South-East Australia "enzootic marasmus" of cattle and sheep in West Australia, "bush sickness" and Morton mains "sheep ailment" in New Zealand and "grand traverse disease" or "lake shore diseae" of cattle in Michigan, are all attributed to cobalt deficiency. Some times the deficiency of cobalt is complicated by concomitant deficiency of copper as in the case of "wasting disease" and "enzootic ataxia" of lambs in Australia. There are many other names usually associated with cobalt deficiency. The deficiency of cobalt in pastures can be rectified by fertilising the soil with soluble cobalt sulphate (at the rate of 2 lb. per acre). The deficiency can be cured by the oral administration of soluble cobalt daily (0·1 mg. per sheep per day and 1 mg. per cattle per head per day). A distinctive feature in sheep with cobalt deficiency is the so-called "rheumy eye". This is a watery discharge from the eyes which mats the wool on the face. Wool production is reduced and the fleece of the affected animal become ragged and open. Other prominent features of this disease are general unthriftiness and anæmia which is also common in copper deficiency in all species.

Manganese.—Experiments on rats have shown that manganese is essential for animal life and it appears to affect growth rate, skeletol metabolism, and development of fœtus. As it is always present in sufficient amounts in all green leafy plants, there is little chance of having manganese deficiency in animals. The so-called "slipped tendon" or "perosis" in chicks, has been attributed to manganese deficiency. Delayed ovulation in some cases in bigger animals, is also due to lack of manganese.

Iodine.—Goitre and cretinism is due to lack of iodine in the food or water. Iodine is essential for normal growth. In the body it is found in the thyroid gland in the form of thyroxine, the active principle of the thyroid gland. Thyroxine is a catalyst affecting the metabolism of the tissue cells, presumably all the cells. Its effect is to increase the metabolism and to maintain it at a higher level than would be maintained, if thyroxine was not present. The deficiency manifests itself with the enlargement of the thyroid gland, resulting from the increased work thrown on it by the efforts to extract iodine and manufacture thyroxine as the available supply of iodine fades.

Zinc and Boron.—Ordinary diets of all animals contain sufficient amounts of zinc and boron, and thus there is no possibility of having the deficiency of either zinc or boron in farm animals.

Toxic Trace Elements.—The toxic trace elements are fluorine, selenium and molybdenum. Spontaneous fluorosis of animals is very common in many parts of the world and particularly in South India. It is particularly common in sheep which die of inanition caused by the wearing down of the incisors and dystrophy of all the permanent teeth. In cows with severe fluorosis, cachexia accompanied by reduced milk yield, lameness, exostoses on long bones and mandibles and hyperplacia of dental enamel are common.

Selenium-poisoning has been reported in some parts of the world and the so-called "alkali disease" manifested by depressed growth and loss of hair is most conspicuous in the mane and tail of horses. Abnormal development and sloughing of hoofs, is now known to be due to selenium-poisoning. Among poultry a conspicuous feature is non-availability of eggs, or hatching of monsters. The "blind staggers" of range cattle in Wyoming is found to be a more acute form of selenosis. The element molybdenum which is widely distributed in traces, is not regarded as essential but like selenium, it can be taken up by healthy plants in quantities injurious to animals. The clearest case of molybdenosis of farmstock is the so-called "teat" of pastures. Bovine hæmaturia in South Australia is at present suspected of being caused by continued ingestion of molybdenum.

All these elements mentioned above, serve the body in different ways. As constituent of bones and teeth they provide rigidity and strength to the skeletal structure. All soft tissues, muscles, organs, and blood cells contain one or more of these elements. They also present as organic compounds in combination with proteins and fats. They are present as soluble salts in blood and other body fluids and serve the body in that capacity. They are equally essential in the maintenance of acid-base equilibrium, in the maintenance of osmotic pressure and other physiological functions. In addition to these general functions in which several minerals may take part, each one of these has various other specific roles to perform.

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STUDIES ON THE SORGHUM SHOOT-BORER-FLY *ATHERIGONA INDICA* MALLOCH (ANTHOMYIDÆ—DIPTERA) AT SIRUGUPPA

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(Communicated by Dr. M. Puttarudriah, Government Entomologist, Bangalore)

I. Introduction

The Sorghum shoot-borer-fly, *Atherigona indica* M., is one of the pests of *jola* (Sorghum). *Jola* figures as one of the most important food crops in the cropping pattern recommended for the Tungabhadra Project *ayacut*,[3] as it forms the staple food of nearly two-thirds of the population living in the Project area. *Jola* is to be cultivated as *khariff*[4] and as well as a *rabi*[5] crop in the *ayacut*. Earlier trials at the Agricultural Research Station, Siruguppa, revealed that *hingari*[6] *jola* was not much of a success as that of *jola* when raised during the *mungari*[7] season, under restricted irrigated conditions. Causes for poor yields of *hingari jola* were investigated specially and it was found that pests and diseases were the major factors affecting the *hingari* yields. One of the chief pests which is of regular occurrence and which causes great loss is the Sorghum shoot-borer-fly, *Atherigona indica*.

II. Nature of Damage, Incidence and Life-History

A. *Nature of Damage*.—Iyyar (1940) has described the damage to *jola* by this fly and Ponniah (1951) has given a more detailed account of the life-history and the correlation between the attack of the fly and resistance in certain varieties of *jola*.

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[3] Command area under an irrigation project.

[4] Monsoon season.

[5] Cold season.

[6] Sown in September-October.

[7] Sown in June-July.

FIG. 1. Attacked (Right) and healthy seedlings when one month old

FIG. 2. Attacked (Left) and healthy seedlings when three months old

Observations made at Siruguppa revealed that the shoot-borer-fly attacked the tender ten-day-old seedlings. Such of those seedlings that escaped the attack till the fifth week from the sowing date were not affected later. The tender growing points were attacked, resulting in dead-hearts and later in profuse grassy growth forming "tussocks", which resulted in poor and unremunerative yields (Photo I).

The attacked plant does not die immediately, but the central shoot wilts, and the plant produces two or occasionally one tiller which may again be attacked by the fly pest. Thus, certain highly susceptible types (*e.g.*, Co. 9 from Coimbatore; American jowars like Milos and Kafirs, etc.) are represented by mere "tussocks" even after three months of growth. The normally non-tillering varieties when attacked by the fly are rather feeble and slow in putting forth new tillers, while the tillering varieties (*e.g., Sorghum roxburgii, S. guinence, S. conspicuum, S. cafrorum* and *S. caudatum*) have fared comparatively better by putting forth tillers immediately. In the case of the tolerably resistant varieties, a good proportion of the plants escape the fly damage.

B. *Incidence.*—A study of the incidence of the fly on the different *jola* varieties raised both in the *mungari* and *hingari* seasons was made. The results are presented in Table I.

TABLE I

A. Mungari *season*

Sl. No.	Variety	No. of plants examined	No. of attacked seedlings	Percentage of attack
1	2	3	4	5
	1949–50			
1	Co. 9 ..	50	4	8
2	Madikattu ..	50	3	6
3	Co. 7 ..	50	4	8
4	Chittoor ..	50	4	8
5	N.J. ..	50	4	8
6	B.J. ..	50	4	8
7	F.W. ..	50	3	6
	1950–51			
1	Chittoor ..	50	2	4
2	Co. 7 .	50	3	6
3	Co. 9 ..	50	4	8
4	Madikattu ..	50	3	6

B. Hingari *season*

Sl. No.	Variety	Origin	Percentage of attacked seedlings					
			1947–48	1948–49	1949–50	1950–51	1951–52	Average
1	2	3	4	5	6	7	8	9
1	J. 75 ..	Guntur	33	41	41	47	*	40
2	J. 103 ..	Guntur	28	41	45	40	33	37
3	H. 1 ..	Hagari	30	42	40	33	39	37
4	M. 31–2 ..	Bombay	46	43	41	38	35	41
5	M. 9–SI–2 ..	Bombay	40	37	39	42	33	38
6	M. 47–3 ..	Bombay	42	44	43	47	38	43
7	N.J. 26/152	Nandyal	30	44	39	40	*	31
8	P.B. 2 R ..	Hyderabad	44	34	38	42	39	39
9	M. 35–1 ..	Bombay	47	42	38	45	39	42
10	N.D. 15 ..	Hyderabad	55	44	40	30	31	40
11	N.J. 1003 ..	Nandyal	47	*	62	48	*	52
12	P.B. 3 R. ..	Hyderabad	36	46	45	34	39	40
13	S.M. 1 ..	Local	46	37	34	32	43	38
14	J. 1962 ..	Guntur	42	45	46	41	36	42
15	Co. 9 ..	Coimbatore	52	62	68	72	60	61

* Figures are not available.

It was noticed that the incidence of *Atherigona indica* on *jola* is more in the *hingari* crop than in the case of the *mungari* crop.

C. *Life-History.*—The life-history of *Atherigona indica* as studied at Siruguppa is as follows: The adult fly is dark-grey in colour and very active in movements. The male is smaller than the female. Eggs are laid horizontally on the undersurface of leaves of young *jola* seedlings. They are cigar-shaped ($1{\cdot}5 \times 0{\cdot}03$ mm. in size) and white in colour. Usually 1-2 eggs are found per leaf, the maximum recorded being 3 per leaf. Egg-laying is confined upto sixth leaf only and mostly distributed from second to fifth leaf (Table II).

It is seen that egg-laying and distribution of the eggs remain more or less the same in both the resistant and susceptible types.

It is reported that the adult fly deposits eggs on the very tender stem of the young seedling (Iyyar, 1940). During the investigations at Siruguppa, no eggs were seen on any part of the stem, but were observed only on the undersurface of leaves. Eggs hatch out into tiny maggots (1·0-1·55 mm. in length) in

TABLE II

Sl. No.	Variety	No. of plants examined	No. of eggs found on						Remarks
			I Leaf	II Leaf	III Leaf	IV Leaf	V Leaf	VI Leaf	Age of seedlings
1	2	3	4	5	6	7	8	9	10
1	Co. 9 (Susceptible)	20	..	..	12	18	7	1	26 days
2	H. 1 (Tolerant) ..	20	..	..	12	24	2	..	
1	Co. 9 (Susceptible)	25	..	2	12	8	..	8	15 days
2	H. 1 (Tolerant) ..	25	..	4	12	12	..	..	

2-3 days. The maggots on hatching find their way into the central shoot. They cut the tender growing point and cause dead-hearts. The detached portion of the leaf begins to decay and the maggots feed on the decaying matter and grow (to a maximum length of about 10-12 mm.) for 10-12 days. The fully grown maggot is yellow in colour and pupates mostly in the stem (at the base of the seedling) and very rarely in the soil. The pupa is dark-brown in colour, with one end being pointed, while the other is a blunt end. The pupal period is about 6-8 days. Thus, the entire life-cycle of the fly is completed in 10-24 days. It was also observed that the maggots did not thrive well under captivity.

III. Varietal Trials for Resistance to the Fly

The ideal method of combating the fly menace would be the growing of varieties that are highly resistant or completely immune to this pest. A world collection of Sorghums of varied genetic origin (involving types from seven countries outside the Indian Union and ten States within India) were tried at Siruguppa, and the results gathered are summarised in Table III.

Table III

Sl. No.	Grade I (Highly resistant)		Grade II (Resistant)		Grade III (Susceptible)		Grade IV (Highly susceptible)	
	Culture	Origin	Culture	Origin	Culture	Origin	Culture	Origin
1	2	3	4	5	6	7	8	9
1	Co. 7	Coimbatore	Co. 2	Coimbatore	Co. 13	Coimbatore	A.S. 3487	Central Province
2	Co. 8	do	Co. 3	do	Co. 15	do	A.S. 4109	do
3	Co. 12	do	Co. 6	do	Co. 16	do	A.S. 4168	N. Rhodesia
4	H 1	Hagari (Bellary)	Co. 9	do	A.S. 224	Adoni	A.S. 4190	do
5	..	..	Co. 14	do	A.S. 4003	Tanganyika	A.S. 4255	Bihar
6	..	..	M. 47–3	Bombay	A.S. 4108	Central Province	A.S. 4537	Kano Nigeria
7	..	..	A.S. 244	Kudligi (Bellary)	A.S. 4116	do	A.S. 4552	Nigeria
8	..	..	A.S. 3996	Kew	A.S. 4135	N. Rhodesia	A.S. 5885	N. Rhodesia
9	..	..	A.S. 4130	N. Rhodesia	A.S. 4185	do	..	..
10	..	..	A.S. 5779	Burma	A.S. 4290	N. Arcot	..	..
11	..	..	..	..	A.S. 4538	Kano Nigeria	..	..
12	..	..	..	..	A.S. 4610	Tanganyika	..	..
13	..	..	..	..	A.S. 4627	do	..	..
14	..	..	..	..	A.S. 4635	do	..	..
15	..	..	..	..	A.S. 4695	Ganjam	..	..
16	..	..	..	..	A.S. 5466	Tanganyika	..	..
17	..	..	..	..	A.S. 5765	Paramakudi	..	..
18	..	..	..	..	A.S. 6187	Kenya	..	..
19	..	..	..	..	A.S. 7638	Belgian Congo	..	..
20	..	..	..	..	A.S. 8155	Madura	..	..

KEY

Grade	Percentage of healthy seedlings
I	80 to 100
II	60 to 80
III	40 to 60
IV	Below 40

It is seen from the table that no variety was absolutely resistant to the fly pest. The percentage of attacked seedlings in the different varieties ranged from 10-100. However, the strains from Bombay and Madras showed a fair amount of tolerance to the fly. It was reported that a positive correlation exists between pest resistance in certain varieties of sorghum to *Atherigona* fly and the accumulation of silica in the leaves (Ponniah, 1951).

IV. Host Range and Habits

Atherigona fly has also been noted on other graminaceous crops (like paddy, *navane*[8] as a minor pest) (Iyyar, 1940). It has also been noted on *samai*,[9] *kuduraivali*[10] and *varagu*[11] at Siruguppa. Examination of grasses growing near about field bunds did not reveal the presence of this fly. *Atherigona* flies were found to rest on the earheads and leaf-spindles of *jola* plants. It was also observed that the flies harboured themselves inside the spindles of the ratoon *jola* crop and on grasses, tomato plants and occasionally on cotton also.

Attempts were made to find out whether the flies underwent any sort of hibernation in the soil, during the off-season. The soil was examined upto a depth of 2-3" and no pupæ were encountered. Stubbles of certain selected *jola* varieties (both susceptible and tolerant) were uprooted and the soil adhering to the roots was carefully examined. The results are presented in Table IV.

The above data show that there is no hibernation of the pest inside the soil, during the off-season. It is quite possible that the infestation is carried on, from season to season, by the adults lurking on any green vegetation like grasses or on other crops like paddy, *navane*, tomato and cotton. The flies seem to pass the entire year on *jola* alone, in the tracts where *jola* is grown extensively throughout the year, either for food or fodder purposes. The observation that the flies infest the ratoons is also significant. This is because *jola* stubbles continues to be neglected and left in the field, thereby carrying the infection from one season to another. The flies manage to lurk in the ratoons

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[8] *Setaria italica.*
[9] *Panicum miliare.*
[10] *Echinocloa colona* var. *frumentacea* (ಊದಲು)
[11] *Panicum miliaceum.*

TABLE IV

Sl. No.	Variety	No. of plants examined	No. of pupæ noted			Average No. of pupæ per 100 plants found in the soil
			Pupæ from which adults have not yet emerged	Empty pupal case	Total	
1	2	3	4	5	6	7
	F. No. 12					
1	Co. 9 (Susceptible)	50	4	12	16	32
2	M. 47–3 (Tolerant)	50	2	8	10	20
3	H. 1 (Tolerant) ..	50	..	10	10	20
	F. No. 11					
1	Co. 9 (Susceptible)	50	2	4	6	12
2	M. 47–3 (Tolerant)	50	3	6	9	18
3	H. 1 (Tolerant) ..	50	2	2	4	16

springing up from the stubbles left after harvest, and await for the next season's crop for their depredations.

V. Remedial Measures

A. *Mechanical.*—Mechanical control measures like netting or bagging is out of question, as the flies are small and very active and, in addition, most of their life-cycle is inside the young seedlings. Light traps were tried but were of no avail. The effect of submerging the young seedlings under water by flooding the plots were studied. The object was to find out whether drowning one-week-old seedlings (the fly infestation is observed to commence from the seventh day from the date of sowing) for different periods, has any effect in reducing the incidence of the fly. The experiment was conducted for five seasons. The following five treatments as major variants and with two varieties (*viz.*, M. 47-3—a tolerant type, and Co. 9—a susceptible variety) as minor ones were adopted in the first two seasons. The treatments were: submerging of one-week-old *jola* seedlings for different time-intervals of 10 minutes; 20 minutes; 30 minutes and 10 minutes with fish-oil-resin-soap, and the control plot received no flooding treatment. Based on the first two years' results, the treatments were suitably modified

and were also increased to seven in the subsequent years. The only change effected was the addition of fish-oil-resin-soap for every time-interval of submersion. The experiment was laid out in split-plot design. The summary of results gathered in this trial is presented in Table V.

TABLE V

Sl. No.	Treatments	Percentage of attacked seedlings				Mean of 2 years	
		1949–50		1950–51			
		A	B	A	B	A	B
1	No flooding. (control) ..	43	64	68	70	56	67
2	Flooding for 10 min. ..	43	62	53	57	48	60
3	Flooding for 20 ,, ..	40	59	54	73	47	56
4	Flooding for 30 ,, ..	39	61	68	72	54	67
5	Flooding for 10 ,, + fish-oil-resin-soap	37	59	63	69	50	64
	'F' test satisfied or not	Yes	Yes	No	No	..	..
	Standard error ..	1·09	0·97	6·3	6·6	..	..
	Critical difference at 5%	3·36	2·97	..	..	..	..

Sl. No.	Treatments	Percentage of attacked seedlings						Mean of 3 years	
		1951–52		1952–53		1953–54			
		A	B	A	B	A	B	A	B
1	Flooding for 10 min. + fish-oil-resin-soap	36	89	56	86	51	65	48	80
2	Flooding for 20 min. + fish-oil-resin-soap	40	91	53	81	53	66	49	79
3	Flooding for 30 min. + fish-oil-resin-soap	41	89	51	79	50	74	47	81
4	Flooding for 10 min. without fish-oil-resin-soap	44	94	53	79	52	67	50	80
5	Flooding for 20 min. without fish-oil-resin-soap	45	91	55	89	46	64	49	81
6	Flooding for 30 min. without fish-oil resin-soap	42	89	50	84	49	60	47	78
7	No flooding (control) ..	56	98	56	83	49	60	54	80
	'F' test satisfied or not..	Yes	No	No	No	No	No	..	..
	Standard error ..	3·6	3·1	2·3	3·5	5·17	5·5	..	..
	Critical difference at 5%	11·0	..	..	..	..	..	..	..

KEY

A = M. 47–3—(Tolerant variety to the fly pest).
B = Co. 9—(Susceptible variety to the fly pest).

It is seen from the first year's data, that two treatments, *viz.*, flooding for 10 minutes with fish-oil-resin-soap and flooding for 20 minutes had significantly low fly attack, while the differences were not marked in the succeeding years (excepting in M. 47-3 series during 1951-52). Statistical analysis of yields also did not reveal any significant differences between the treatments under test. It was also observed that no harmful effects were noticeable on the crop, due to the flooding treatments given.

B. *Cultural.*—(*i*) *Regulation of Planting Time.*—A time of sowing experiment was conducted with the main object of finding out the optimum time for sowing irrigated *rabi jola* in the Project area. Incidentally, the incidence of the fly was also studied in this trial. The experiment was conducted for three seasons. In the first year, eight sowing dates at fortnightly intervals, commencing from 1st September and ending with 15th December were tried. Since the November and later sown batches failed completely, the observations were restricted to four sowing dates only in the subsequent years. The summary of results gathered in this trial is presented in Table VI.

TABLE VI

Sl. No.	Sowing date	1946–47			1947–47			1948–49			Acre yields in lb. (Average for 3 years	
		% of fly attack		Rainfall in inches *	% of fly attack		Rainfall in inches *	% of fly attack		Rainfall in inches *	Grain (Mean of 2 varieties)	Straw (Mean of 2 varieties)
		M. 47-3	H. 1		M. 47-3	H. 1		M. 47-3	H. 1			
1	2	3	4	5	6	7	8	9	10	11	12	13
1	1st September ..	26	22	0·88	65	66	8·30	58	54	5·75	884	2419
2	15th do ..	74	72	1·44	61	61	0·20	47	44	4·45	1254	3916
3	1st October ..	47	50	0·08	66	69	2·20	44	48	2·08	693	3996
4	15th do ..	80	69	1·76	61	60	Nil	61	50	0·64	969	3218
	'F' test satisfied or not	..	..	..	Yes	Yes	..	Yes	Yes	..	..	..
	Standard error ..	..	..	..	2·2	2·3	..	2·2	1·8	..	..	..
	C.D. at 5% ..	..	..	..	6·3	6·9	..	6·6	5·3	..	..	..

N.B.—* Rainfall received during the period of fly incidence—*i.e.*, 10th to 30th day from the sowing date.

It is seen from the above figures that the trend of incidence does not appear to be influenced either by the time of sowing or the intensity of rainfall received during the period of infestation. It is, however, seen from the yield data that plantings done on 15th September have recorded the highest grain yields. In view of the high yields, mid-September has been recommended as the optimum sowing period, for raising of *hingari*-irrigated *jola* in the Project area. Thus, it is seen that by regulating the planting time suitably (without sacrificing yields), the fly incidence cannot be eliminated. These results are in full agreement with those of the findings (based on the preliminary trials) reported by Ponniah (1951).

(*ii*) *Time of Irrigation.*—A time of irrigation experiment was conducted for two seasons, with the main object of finding out the optimum time for giving irrigation to *hingari jola.* The treatments included in this trial were: (*a*) no irrigation after starting of the crop (control); (*b*) irrigation once only after four weeks; (*c*) irrigation once only after six weeks; (*d*) irrigation once only after eight weeks; (*e*) irrigation once only after ten weeks from the date of sowing, and (*f*) irrigation once in every fortnight. The incidence of the fly was not recorded in the first year, as the crop did not receive any irrigation till the sixth week due to the breakdown of the engine. The data gathered in the second year are presented in Table VII.

TABLE VII

Sl. No.	Treatments	Percentage of fly attack		Mean of 2 varieties
		M. 47–3	H. 1	
1	No irrigation (control) ..	46·5	48·5	47·5
2	Irrigation once only after 4 weeks ..	45·2	51·5	48·3
3	do 6 weeks ..	49·5	51·3	50·4
4	do 8 weeks ..	49·2	52·3	50·7
5	do 10 weeks ..	45·75	55·5	50·6
6	do 15 weeks ..	49·75	55·8	52·7
	'F' test satisfied or not ..	Not satisfied	Not satisfied	..

It is seen from the above figures that there are no significant differences between the irrigation treatments given, in respect of the fly damage.

(*iii*) *Trap Crops.*—In order to test how far the minor millets, already noted as alternate hosts act as traps, the mixtures (in 1 : 1 ratio) and the pure plots were studied for two seasons. The data gathered in this trial are presented in Table VIII.

TABLE VIII

Sl. No.	Treatments	Percentage of fly attack			Remarks
		Co. 9	T. 1	M. 47-3	
1	2	3	4	5	6
	1945–46				
1	Pure crop of *jola* ..	78	53	54	Studied in non-replicated observation plots
2	*Jola* and *samai* ..	57	25	40	
3	*Jola* and *varagu* ..	70	17	33	
4	*Jola* and *kuduraivali* ..	48	18	21	
	1946–47				
1	Pure crop of *jola* ..	87·7	..	41·7	Since mixture with *kuduraivali* recorded lowest incidence in 1945–46, the trial was restricted with this mixture only during 1946–47
2	*Jola and kuduraivali* ..	83·5	..	38·7	
	'F' test significant or not	Not significant	..	Not significant	

It is seen from the above figures, that in the first year, the trends were in favour of mixture plots, these showing a lower incidence of fly attack than the plots sown with pure crops. The second year's results did not reveal any significant differences between the pure and mixture plots. In addition, the growing of mixtures is not an economical proposition.

(*iv*) *Plant Vigour.*—With a view to study, if plant vigour brought about by any means, has any relation to the shoot-borer-fly-attack, the following trials were conducted. The probable factors which contribute vigour to seedlings are (*a*) seed size; (*b*) intensive manuring; and (*c*) heterosis. The first two factors were studied in respect of the *jola* fly attack at Siruguppa.

(*a*) The seeds were graded into big, medium and small and sown in randomised and replicated plots. Fly counts recorded in this trial are presented in Table IX.

TABLE IX

Sl. No.	Treatments	Percentage of fly attack		
		M. 47-3	H. 1	Co. 9
1	2	3	4	5
1	Big sized grain ..	19·0	22·2	64·0
2	Medium-sized grain ..	30·2	25·2	65·7
3	Small-sized grain ..	27·7	23·5	62·7
	'F' test satisfied or not	Not satisfied	Not satisfied	Not satisfied

It is seen from the above figures that the differences between the different grades of seeds are not significant.

(*b*) For studying the relationship between plant vigour caused by intensive manuring and the fly attack, different manures were applied at varied dosage levels. In the first year, groundnut cake was applied, while in the subsequent years, both ammonium sulphate and groundnut cake were tested at different doses. Ponniah (1951) reported that extra vigour brought about by the addition of manures did not seem to alter the fly incidence. But, the observations recorded at Siruguppa by the authors run counter to the above statement, as will be seen from the following experimental results.

A manurial experiment was laid out with different manures, based on the manurial schedules recommended for the Project area. The results gathered in this trial are furnished in Table X.

It was seen from the crop growth that the manured plots showed increased vigour than the no-manured plots. But, the fly attack was also observed to be higher in the manured plots than in the no-manure plots. The differences in fly attack between the treatments were statistically significant in four out of five seasons in the case of Co. 9, while the data was significant in two seasons only, in the case of M. 47-3 variety. It is quite likely that the fly may have a preference to vigorous seedlings than to the weak and lanky ones. It is also interesting to note here that despite the higher fly incidence in the manured plots, they have registered good yields. The greater vigour and the consequent good growth of the manured plants have by far compensated the loss due to fly attack and this might have

TABLE X

Sl. No.	Treatments	Percentage of attacked seedlings		Varietal means
		Varieties		
		M. 47-3	Co. 9	
	1949-50			
1	Farmyard manure at 20 N per acre ..	16	44	30
2	Groundnut cake at 60 N per acre ..	20	49	35
3	No manure—control ..	19	43	31
	'F' test satisfied or not :	No	Yes	..
	Standard error ..	..	0·83	..
	Critical difference at 5 % ..	..	2·8	..

Sl. No.	Treatments	Percentage of attacked seedlings								Mean of 4 years	
		1950-51		1951-52		1952-53		1953-54			
		Varieties		Varieties		Varieties		Varieties			
		M. 47-3	Co. 9	M. 47-3	Co. 9	M. 47-3	Co. 9	M. 47-3	Co. 9	M. 47-3	Co. 9
1	2	3	4	5	6	7	8	9	10	11	12
1	Farmyard manure at 20 cart load per acre	62	78	46	87	83	87	47	88	60	85
2	Groundnut cake at 60 N per acre	60	75	45	93	65	95	59	92	57	89
3	Ammonium sulphate at 60 N per acre	61	76	45	94	62	94	56	94	56	90
4	Groundnut cake + Ammonium sulphate at 60 N per acre (50 : 50)	61	77	44	93	62	94	57	95	56	90
5	No manure—control..	51	77	56	98	52	90	59	92	55	89
	'F' test satisfied or not	No	No	No	Yes	Yes	Yes	Yes	Yes	..	..
	Standard error ..	3·2	2·7	3·7	1·6	2·6	1·0	2·5	0·95	..	..
	Critical difference at 5%	..	..	..	5·0	6·0	3·0	7·9	2·9	..	..

contributed towards higher yields. In short, the yield trends were in favour of manuring the crop.

(*v*) *Transplantation of Seedlings.*—In order to study how far transplanting of one-month-old seedlings could be adopted in combating the fly pest, as against the normal drill sowing, transplanting system of raising the crop was studied. Though the fly incidence could be more or less eliminated by transplanting one-month-old healthy seedlings, the final crop yields (both grain and straw) in the two systems of plantings were almost similar. This is because many factors other than fly attack go to make up the final yields. Transplanting method of raising crops demands extra labour and water, resulting in greater cultivation coats than the drill sowing method. As no substantial benefits could be achieved by adopting transplanting system in the case of *jola* crop, only drill sowing will have to be preferred.

C. *Insecticidal Trials.*—BHC and DDT were tried in the control of *Atherigona* fly both as a dust and also as a spray, in different strengths and with repeated sprayings, varying from 1-4 rounds at 10-day intervals. The summary of results gathered in this trial is presented in Table XI.

TABLE XI

Sl. No.	Treatments	1950–51 M. 47–3 (% of fly attack)	Treatments	Per cent. of fly attack M. 47–3	Per cent. of fly attack Co. 9
	Spraying Trials		Dusting Trials		
1	DDT .. 0·10%	65	1 BHC .. 5%	41	51
2	DDT .. 0·05%	67	2 DDT .. 5%	57	64
3	BHC .. 0·10%	19	3 Control (No treatment)	56	67
4	BHC .. 0·05%	24			
5	No spraying (control)	65			
	'F' test satisfied or not	Yes	..	Not satisfied	Not satisfied
	Standard error ..	1·4	S.E. ..	5·5	5·07
	Critical difference at 5%	4·47	..	..	..

It is seen from the above figures that as a dust both BHC and DDT have failed to be effective in checking the incidence of *Atherigona* fly. As a spray, BHC is more effective than DDT against the *jola* shoot-borer-fly. It was found that the differences between the concentrations used and the time intervals given were not significant.

Sl. No.	Treatments	1951–52 (% of fly attack)		1952–53 (% of fly attack)		1953–54 (% of fly attack)		Mean of 3 years (% of fly attack)	
		M. 47–3	Co. 9	M. 47–3	Co. 9	M. 47–3	Co. 9	M. 47–3	Co. 9
1	2	3	4	5	6	7	8	9	10
	Combined trial of Dusting and Spraying								
1	Control (no treatment)	52	96	56	90	59	92	52	93
2	BHC (Dust) 5%	43	93	60	93	61	90	55	92
3	BHC (Spray) 0·05%	43	89	51	88	51	89	48	89
4	BHC (Spray) 0·10%	38	88	41	78	45	85	41	84
5	DDT (Dust) 5%	53	92	53	91	63	92	56	92
6	DDT (Spray) 0·05%	45	89	66	91	67	91	59	90
7	DDT (Spray) 0·10%	49	89	68	92	68	92	62	91
	'F' test satisfied or not	..	..	Yes	Yes	Yes	Yes	..	..
	Standard error ..	..	..	1·7	1·8	1·6	1·23	..	..
	Critical difference at 5%	..	..	5·4	5·4	5·05	3·88	..	..

D. *Increased Seed Rate Experiment.*—Rao (1954) has reported that remunerative yields of irrigated *hingari jola* could be obtained by using a heavier seed rate than normal. Since none of the measures tried was completely effective in the control of the fly, the use of higher seed rate and thinning after the fly phase is over, were tried to get over the ill-effects of the fly damage and obtain normal yields. Prior to the laying out of regular seed rate trials, a feeler experiment was conducted with two treatments only (*viz.*, 12 lb. per acre and 24 lb. per acre *plus* thinning at the end of the fourth week from sowing date) in large plots. The results of these preliminary studies are presented in Table XII.

It is seen from the above figures that plots with heavier seed rate have yielded more per acre, though the difference in fly attack between the two treatments are not marked.

In order to fix the optimum seed rate for achieving remunerative yields, a regular seed rate experiment was laid out with the following treatments. They are : (*a*) 8 lb. per acre; (*b*) 12 lb. per acre; (*c*) 16 lb. per acre; *plus* thinning at the end of the fourth week from the date of sowing; (*d*) 20 lb. per acre *plus* thinning at the end of the fourth week from the date of sowing. The summary of results gathered in this experiment is presented in Table XIII.

Table XII

Sl. No.	Particulars	Normal seed rate (12 lb. per acre) Control		Thick seed rate (24 lb. per acre + thinning at the end of 4th week)	
		Grain	Straw	Grain	Straw
	1. M. 47-3 Series				
1	Yield per acre in lb.	1029 (100)	3319 (100)	1166 (113)	3640 (110)
2	Per cent. of fly attack	47 (100)		45 (96)	
3	Net profit per acre over the control plot	..	..	Rs. 24-5-0	
	2. Co. 9 Series				
1	Yield per acre in lb.	942 (100)	1839 (100)	960 (102)	2027 (110)
2	Per cent. of cholam fly attack	92 (100)		83 (90)	
3	New profit per acre over the control plot	..	..	Rs. 3-0-0	

N.B. (1) Averags of 2 seasons' figures are furnished in this table.
(2) Figures within brackets indicate per cent. on control.

Table XIII

Mean of three years

Sl. No.	Treatments	Co. 9—series					M. 47-3—series				
		Acre yield in lb.		Per centage of fly attack	Yields per cent. on control		Acre yields in lb.		Per-centage of fly attack	Yeilds per cent. on control	
		Grain	Straw		Grain	Straw	Grain	Straw		Grain	Straw
1	8 lb. (Control)	449	1079	56·9	100	100	544	1671	39·8	100	100
2	12 lb.	488	1129	53·1	109	103	665	1886	42·2	122	113
3	16 lb. + thinning	479	1249	57·1	107	115	613	1507*	41·8	113	90
4	20 lb. + thinning	476	1294	56·5	106	120	653	4746	39·7	120	104

REMARKS: * This is because of low figure obtained during 1953—54.

It will be seen from the above figures that the differences in the fly attack between the treatments under test is not very marked. The establishment of a good and uniform stand is one

of the prerequisites to obtain high yields. It is seen that the treatment—12 lb. per acre has given higher yields than the rest. The normal seed rate usually used by a *ryot* is about 8 lb. per acre. In order to make up for the fly damage and to obtain remunerative yields, a higher seed rate of 12-16 lb. per acre, can be recommended with advantage, for general adoption in the Tungabhadra Project area.

Summary and Conclusions

The life-history and bionomics of the *jola* fly (*Atherigona indica* M.) were studied. Among the world collection of sorghums tested, none was completely immune to the fly pest. Varieties fairly tolerant to the fly were isolated. The various remedial measures tried to combat fly damage and the results achieved have been presented. Raising of tolerant types and adoption of higher seed rate and thinning of the crop when one-month-old, have been recommended to get over the ill-effects of the fly menace.

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ROLE OF PRIVATE AGENCIES IN AGRICULTURAL CREDIT IN INDIA*

By B. A. Bala Chowdiah[1]

Rural indebtedness is not peculiar to India alone. It is a feature of all agricultural countries. It is chronic in this country because the population is increasing without a corresponding increase in cultivated area and the cultivation unit is becoming more and more undersized and fragmented. Thus the number depending upon land is much larger than it can maintain at a desirable standard of life. This situation is worsened by the inadequate development of subsidiary and cottage industries and the vagaries of nature to which the yield from land is subjected to a very great extent.

The Indian agriculturist needs several kinds of credit. He needs production credit as well as consumption credit besides credit for effecting permanent improvements to his land and for discharging his inherited debt liabilities. A striking peculiarity of the agriculturist's position in this regard is that he has pressing need to borrow but has absolutely nothing to offer as security. It is the private agencies in the rural areas, *viz.*, the indigenous bankers and money-lenders who, being suitably adapted to this situation, have been meeting such credit needs of our agriculturists.

Despite the development of organized commercial banking and the growth of co-operative credit institutions in the country, the private money-lenders still occupy a very important place in the credit structure of our rural economy. The village banker, who is called by different names in different parts of the country, is carrying on his lending business as successfully as ever. He may be also a landlord or merchant or commission agent. He is the chief source of credit and provides the predominantly greater proportion of rural finance. There is no gainsaying the fact that organized banking and co-operative credit have made little advance in the countryside.

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The popularity of the village money-lender as a source of rural finance is due to several reasons. He satisfies, in an admirable manner, the essential requisites of rural finance. His methods are elastic in the sense that he appreciates the need of the agriculturist and adapts his business suitably irrespective of whether his client is able to offer any security or not. The long delay and elaborate formalities to which institutional credit is subjected is absent in the case of this local credit. It is this prompt and ready finance which has attracted the agriculturist as well as the village artisan and merchant.

However, the village money-lender resorts to certain practices which are not desirable in the interests of his borrowers. He charges exorbitant rates of interest. Though it may be argued that the high rates of interest charged by the money-lender are a safeguard against possible risks in his business, it is considered unjust to penalise all for the wrong committed by a few defaulters. He does not maintain proper accounts nor does he issue receipts for the payments received. Very often the greedy money-lender manipulates his accounts to his own advantage because his debtor is unable, due to ignorance, to understand and scrutinize any account. If the money-lender is a merchant he compels his debtor to surrender his produce. In such cases, the money-lender dictates the price and exploits the poor cultivator. The consequence of such exploitation is that agricultural land gradually passes from agriculturists to non-agriculturists and the yield from it deteriorates through neglect. Another criticism against money-lender credit is that he lends for all purposes, productive as well as unproductive. He is indifferent to check the use to which his advance is put. It is these practices of the money-lender which require to be regulated with a view to ensure that the credit he provides is utilized for increasing the income of the borrowing cultivators.

Thus it may be concluded from the foregoing account that the private money-lenders in our rural areas will continue to play a very prominent role in providing agricultural finance. They are indispensable to our rural economy. Any attempt to eliminate them from our villages will be absolutely powerless. On the other hand, the village money-lender must be retained and enabled to play a more useful role. The most important step to be taken in regard to this is that he must be linked to the organized banking structure of the country

so that he will form an organic part of the country's credit structure. The isolation of indigenous credit from organized credit must be put an end to and the indigenous banker should be made to feel that he is part of the country's organized credit structure. This is also necessary for making the credit controlling operations of the Reserve Bank of India effective in the rural areas as well. He must be enabled to receive help, by way of funds, from the Reserve Bank during the busy season when his own resources may prove inadequate. Further it is my humble suggestion that the Reserve Bank of India may arrange for holding periodical conferences of indigenous money-lenders in the several regions of the country to discuss their local problems and to educate them with a view to make their business more useful to the rural community. The indigenous lenders must be made to realise that since the repaying capacity of their borrowers depends upon their income, it is very essential that they should insist upon their borrowers utilising their borrowed funds for cultivation and other productive purposes only. The money-lenders should encourage thrift in the rural areas and receive deposits which will supplement their own resources. Long-term credit, however, must continue to spring from institutions like Land Mortgage Banks because the great majority of private money-lenders depend upon their own limited resources which they would be unable to lock up by providing long-term finance. The business side of their activities must be separated from their money-lending activities and the latter should not create undue privileges for the lender to resort to evil practices in the former. The rates of interest must be normal and be related to the prevailing rates of interest and local conditions. Proper accounts must be maintained by them and regular receipts must be issued for amounts received. Their accounts must be subjected to periodical scrutiny by the Reserve Bank. The statutory provisions relating to licensing and registration of money-lenders must be diligently enforced.

As pointed out above, some of the practices of the money-lenders are inimical to the interests of the debtors. Acts have been passed in the various States in the country to control and regulate money-lending. But the Agricultural Finance Sub-Committee of the Policy Committee on Agriculture, Forestry and Fisheries (1944-45) and the Rural Banking Enquiry Committee (1950) feel that the working of these Acts has resulted in some contraction of rural credit in the country. Hence there must be

a cautious approach to the problem of regulating money-lending. It is now evident that the village money-lender must be retained. His sensitiveness and reaction to statutory regulation must be carefully observed and suitable measures have to be evolved to respect his individuality and at the same time utilize his resources and adaptability for the good of our cultivators without enforcing rigorous restrictions on his business. In this connection the valuable recommendations of the Agricultural Finance Sub-Committee presided over by Prof. D. R. Gadgil demand close consideration by legislators contemplating legislation in this regard in future.

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OCCURRENCE OF THE SUGARCANE WHITE-FLY, *NEOMASKELLIA BERGII* SIGNORET, IN THE VISVESVARAYA CANAL TRACT

By S. Usman and K. S. Sivashankar Sastry[1]

I. Introduction

The sugarcane white-fly, *Neomaskellia bergii* Signoret, along with the allied species, *Aleurolobus barodensis* Maskell (Aleyrodidæ, Hemiptera), is known to occur on sugarcane in Mysore State (Usman and Puttarudriah, 1955). However, in November 1953, *N. bergii* was found in a severe form in certain ratoon cane plots from which it was spreading to the neighbouring experimental plots in the V. C. Farm. Colonies of nymphs and puparia were found practically all over the leaves in almost all the canes. Thousands of these white-flies appear and suck up the sap as a result of which the canes appear sickly and withered. The white-flies produce the honey dew in large quantities, which falls on the leaves giving rise to the black sooty mould. The pest is now recurring year after year, though in a mild form, and is spreading to new localities, such as Bansvadi, Goravale, Sabanahalli, Anambadi and Vaidyanathapura in the V. C. Tract. Although a highly localised sporadic pest at present, its potentialities for multiplication and spread, thus developing into a serious menace to the sugarcane crop in localised areas, cannot be overlooked.

II. Distribution and Hosts

N. bergii has been recorded from several sugarcane growing countries of the world. Box (1953) gives its distribution as Mauritius, India, Java, Formosa, Caroline Is., Philippines, Queensland, Samoa, New Caledonia, Guam and Fiji. In India it is known to be a minor pest of sugarcane in Bihar, Madhya Pradesh, Uttar Pradesh, Punjab, Bombay and Madras (Fletcher, 1917, and Misra, 1919). Besides sugarcane, it occurs on *jola* and certain wild hosts.

III. Life-History

The Egg.—Eggs are laid in two or more concentric circles or semi-circles and each cluster may contain 75-120 eggs. The

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eggs, with the female ovipositing them on the leaf, is a conspicuous object. Ants attend on the female white-fly while egg-laying for honey dew.

Eggs (0·25 mm.) are elliptical, broad at base, stalked and shining pale yellow in colour changing to dusky brown and finally to dark brown. Incubation period 2-4 days.

The Nymph (0·25 mm -2·0 mm.).—Newly hatched nymphs are pale brown and soon settle down to feed on the succulent leaf. The nymph moults four times; in the first two instars, it is larval in character, whereas the last two instars are considered to be pre-pupal and pupal stages. In the larval instars the nymph is thin, elliptical with striations on the convex dorsum. The puparium becomes thick, chitinous and dark brown in colour with a distinct marginal fringe. The pupal case is also elliptical with reflexed edges, armed with a row of marginal spines. Larval period occupies 5 to 7 days and the pupal stage 7 to 10 days. The total development occupies 2 to 3 weeks as follows :

Egg—2 to 4 days; larva—5 to 7 days; and pupa—7 to 10 days. Misra (1919) recorded that the life-cycle was completed in 20 to 22 days in Bihar.

The Adult (2·0 mm. to 2·5 mm.).—The adult white-fly is yellow to orange red in colour ; antennæ short, thin, 7-segmented ; forewings long, thick with brown transverse patches, and the hindwings comparatively shorter, thin and transparent ; the abdomen of the male is long, with a pair of terminal claspers, whereas in the female it is thickest and broad, with a short ovipositor at the extremity ; the most characteristic organ of the white-flies is the vasiform orifice on the dorsal surface of the last abdominal segment, which is a membranous structure helpful in defecation and throwing away of the excreta.

The adults live for 3-4 days, but easily succumb to high temperatures.

IV. Natural Enemies

Parasites.—As many as five natural parasites were obtained from the puparia, of which four are Aphelinids (Hymenoptera)—*Azotus* sp., *Coccophagus* sp., *Eretmocerus serius* Silvestri and *Prospaltella* sp., and one Scelionid (Hymenoptera) *Amitus aleurolobi* Mani. There is a very heavy parasitisation, which may be as high as 90% during certain seasons (November-December).

Predators.—Scymnus sp. (Coccinelidæ, Coleoptera) has been found in association with the nymphs of the sugarcane white-flies. A species of this genus is recorded as a predator on *N. bergii* from Bihar (Misra, 1919).

V. Control Measures

The prompt removal and destruction of early attacked foliage will prevent the multiplication of this pest. In bad cases, a spray with a contact insecticide like Folidol E 605 0·05% (a Bayer's product) has been found to be effective, though it was necessary to repeat the treatment after 3-4 weeks.

In view of the very high natural parasitisation of the nymphs and puparia, the pest outbreak is usually checked automatically at a late stage.

VI. Acknowledgment

We are grateful to Dr. M. Puttarudriah, Government Entomologist, for guidance and facilities. Our thanks are due to the Director and authorities of the Commonwealth Institute of Entomology, London, for determination of the parasites noted here.

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JAGGERY, BOORA SUGAR AND OPEN PAN SUGAR

By K. Lakshminarayana Bhatta*

(*Continued from Vol. XXXI. No. 2, page 124*)

IV

OPEN PAN CRYSTAL SUGAR

To most of us, crystal sugar is synonymous with factory white sugar. It is associated in our mind with huge modern factories, where truckloads of sugarcane enter at one end, and bags of sugar roll out at the other. But not so very long ago, sugar was primarily a product of small-scale manufacture on the farm of the cane-grower. Even today, in the Uttar Pradesh and certain other parts of the Indian Union, crystal sugar is produced on a cottage industry basis. In Uttar Pradesh, it is an important industry and a great deal of attention has been devoted to its improvement. Many technological improvements in the manufacturing process have been introduced, which have resulted in upgrading the quality and increasing the recovery of sugar produced. This industry once flourished in Mysore and there is no reason why it should not be revived. During the past few years, a method of preparing crystal sugar on a cottage industry basis in Mysore has been evolved and its practicability demonstrated by systematic work, both on Government farms and on private estates. The method is less elaborate than that now being popularised in Uttar Pradesh but is suited to our requirements and resources. It deserves an earnest trial at the hands of enterprising cane-growers.

The principles underlying the preparation of sugar from sugarcane, whether on the farm or at the factory, are essentially the same. The sugarcane is milled and the juice is filtered to remove coarse dirt. It is then heated and treated with chemicals (clarifying agents) when part of the non-sugars is thrown out as scum or mud. This is removed by filtration and the juice concentrated to a syrup. At the proper stage of concentration, the syrup is transferred to 'crystallisers' where it is slowly cooled. A major part of the sugar then

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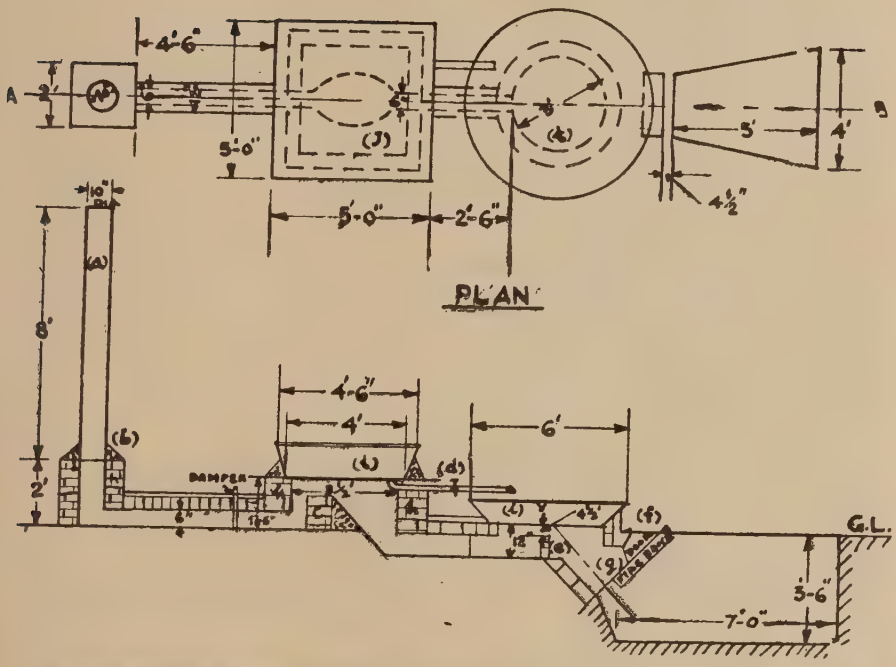
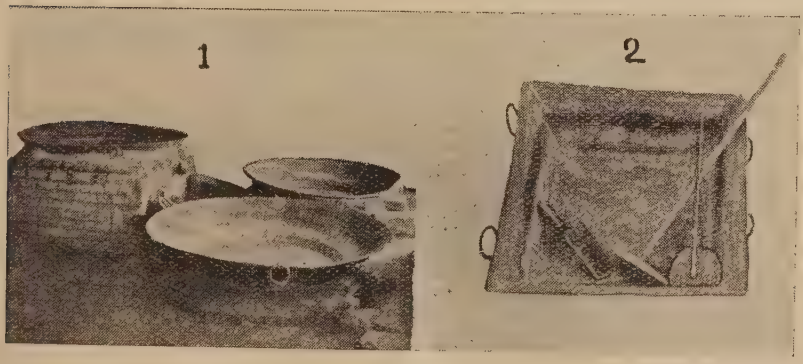
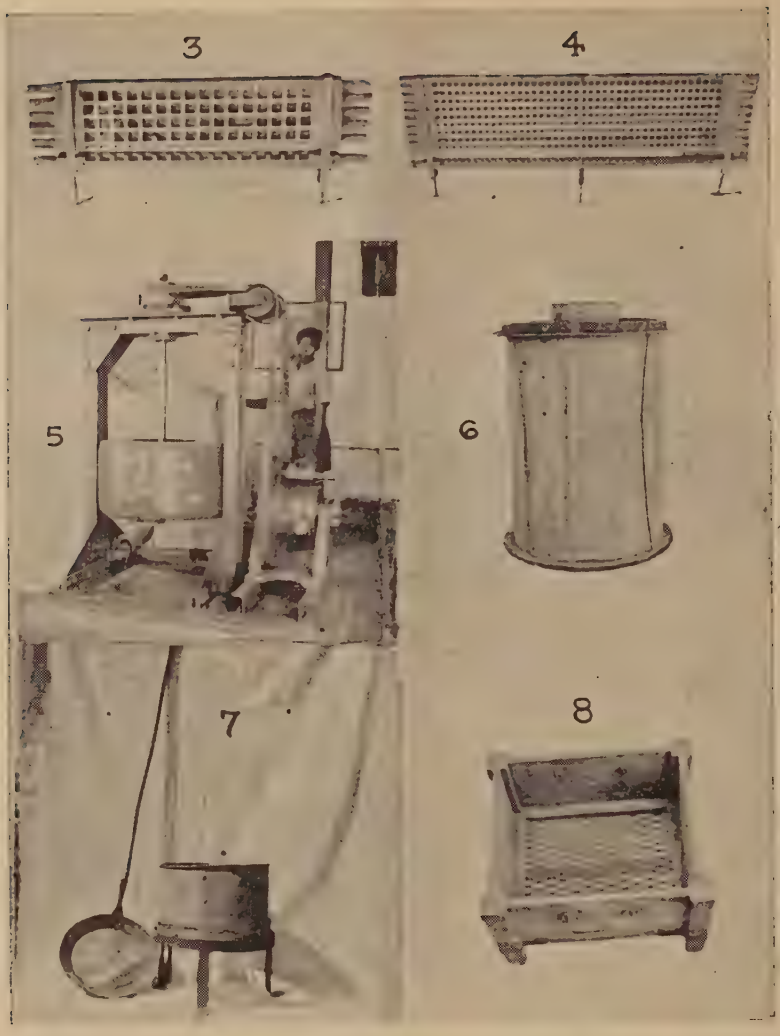
HEBBAL FURNACE





(1) Jaggery boiling pans. (2) Cooling pan and scraper *(Gorumane)*.



(3) Hebbal mould. (4) Babbur mould. (5) Centrifugal machine.
(6) Crystalliser drum. (7) Filter stand and filter. (8) Sand filter.
(9) Sieve for crystal sugar.

separates out in the form of crystals, the mixture of crystal and syrup being known as *Rab*. This *rab* is 'cured' in a centrifugal machine, which retains the sugar and throws out the residual syrup or molasses. The molasses can be concentrated again, to give a second crop of sugar. This may be repeated a third time. The final or exhaust molasses obtained still contains some sugar which cannot be separated by further concentration. The sugar obtained is washed, dried, rolled to break down lumps, graded and bagged.

The essential difference between the process as adopted in the factory and that on the farm is, that in the factory, the juice is concentrated under reduced pressure in vacuum pans heated by steam, while on the farm it is concentrated in open pans heated directly by begasse or other fuel. For this reason, sugar produced by this process is called open pan sugar. The percentage recovery of sugar by this open pan process is 3 or 4 per cent. less than in the factory, but this disadvantage can be offset by converting the molasses, into a wholesome edible product like jaggery. The process advocated in Mysore is based on this principle.

Equipment

For this process, certain additional equipment, over and above what is available in a normal jaggery boiling unit are necessary. These are : (1) a 10 H.P. motor or oil engine, (2) a centrifugal machine capable of taking a load of 20-30 lb. of *rab*, (3) a crystalliser, (4) a two-gallon sprayer, and (5) a thermometer reading to 150° C. Minor accessories, such as mats and carpets for drying sugar, basins, trays, etc., are also necessary.

The crystalliser, as the name indicates, is a receptacle for inducing the sugar in syrup to separate out as crystals. The object to be achieved is firstly, to make as much as possible of the sugar to crystallise and, secondly, to make the individual crystals to grow as big as possible. For this purpose, the syrup should be cooled very slowly and stirred now and then to maintain the whole mass at nearly the same temperature. Stirring also prevents the formation of lumps. The essential features of a crystalliser are that it should be insulated to prevent rapid cooling of the rab and that it should have a stirrer arrangement. The simplest type of crystalliser is a big copper pot (ಹಂಡೆ) or wooden barrel with a capacity of about

25 gallons. This should be wound round with a double layer of straw roping, excepting the mouth, and stitched up with a double layer of gunny. A wooden beam of suitable length and slightly broader at the working end, serves as a stirrer. It should be closed with a tight-fitting wooden board similarly insulated on the outside. For continuous working with a double pan furnace, 3 crystallisers of this type will be required.

The Bilari Research Station has designed and put into use a revolvng crystalliser, which can be worked by hand or geared on to a motor. Comparative tests carried out here in 1942-43 showed that it offered no advantage over the above type either in the size or the recovery of crystals, or in the time required for crystallisation. More recently, the same Institution has put up a U-shaped crystalliser with stirrer attachment, but this has not yet been tested in Mysore. For our present purpose, the simple crystalliser described above may be considered adequate.

Centrifugal machines suited to our requirement are available in the country. Machines put on the market by the Kirloskar Company and by M/s. Berry Bros., of Calcutta, are satisfactory.

The motor or oil engine which is used to drive the cane mill can also be used to drive the centrifugal machine.

The other accessories can be procured locally at a small cost.

The Process

The clarification and concentration of the juice are the same as indicated under quality jaggery. Either lime and superphosphate, or lime followed by active carbon can be used as clarificants. In the latter case, a whiter and cleaner product is obtained. The clarified juice is then concentrated until the temperature rises to 108-09° C., as indicated by the thermometer. The syrup is transferred to a cooling pan at this stage where it is stirred with a wooden ladle until it cools to about 90° C. and is then poured into the crystalliser. The crystalliser is closed tight and allowed to stand. The strike-point can be judged, after a little practice, from the appearance of the boiling syrup and its feel when a drop is pressed between finger and thumb, but it is always safer to use a thermometer to prevent any over-heating.

The crystalliser has a capacity of 25 gallons and can take in the *rab* from 5 to 6 charges, *i.e.*, the total syrup from a day's working. As each fresh charge is poured into it, the contents are stirred once. After all the charges are added, it is closed tight and left to stand. It should be opened once every 2 hours, stirred slowly with the stirrer and closed again. At the end of 3 days, the *rabs* will have cooled down to room temperature and the crystallisation will be complete. The contents are then poured into large basins and prepared for spinning. The crystalliser filled the first day will be available for filling again on the fourth day so that with a set of 3 crystallisers, the process can be continuous.

The *rab* is then taken in basins and any lumps formed broken up by gentle pressure with a small wooden mallet. It is then centrifuged in the machine, washed once or twice with a spray of cold water, using a two-gallon sprayer, till the washings indicate that the sugar is free from molasses and the sugar is then taken out. It is dried on carpets or other cloth spread out in the sun. The sunlight, besides drying it, has a bleaching effect. The sugar is then rolled to break down lumps and bagged. A recovery of 6-6·5 per cent. is obtained.

The molasses still contains a good deal of sugar and this can be worked up by concentrating the molasses and allowing it to crystallise further. A recovery of 1·0-1·5 per cent. of second sugar is obtained, bringing the total recovery to 7·0-7·5 per cent. on cane.

This still leaves some molasses on hand and to throw it away would mean the loss of much precious nutritional material. To obviate this difficulty, the method proposed is to recover first sugars and to mix the first molasses with fresh juice and prepare jaggery. The molasses jaggery thus prepared is just as good as that from raw juice, both in appearance and taste.

Molasses jaggery is prepared as follows. Two hundred pounds of fresh juice are clarified and boiled to syrup till the temperature rises to 108° C. Then 60 lb. of molasses are carefully neutralised with lime cream, poured into the pan and thoroughly mixed. The combined melt is then concentrated and struck into jaggery in the usual manner.

From a series of tests carried out it has been found that the most economical way of preparing open pan sugar is to prepare first sugars and convert the first molasses to jaggery.

It may be mentioned here that in Uttar Pradesh the Bilari Institute has been popularising the sulphitation process, in which sulphur dioxide is used for clarification of juice in the production of open pan sugar. Additional equipment, such as a sulphur tower, settling tanks, special furnaces, etc., have been devised for the purpose. The process is reported to be popular with *khandsaris* (open pan sugar-makers) and to result in a high recovery (7-8 per cent.) of good quality sugar. Whether these improvements can be adopted in Mysore, is still a question to be settled by actual tests and pilot-scale experiments. It would however seem that under our conditions, and in the present state of development of the open pan industry, the process would be much too elaborate and it can be considered only when the simple process described above becomes well established.

The production of crystal sugar by open pan process, described above, has been successfully demonstrated at several districts and Dasara exhibitions. The economics of the process has been carefully tested by large-scale tests on Government farms as well as on two private estates, one at Bhadravathi and one in Kolar District. These tests were carried out some years ago when sugar was scarce and jaggery prices were low. The costs and profits have perhaps to be worked out afresh in the context of current prices, but there seems little doubt that, with proper care, the process can be worked with good profit to the cane-growers.[12]

V

SOME ADDITIONAL INFORMATION

In the following pages are given information relating to varieties, manuring, equipment necessary for a jaggery unit, etc., which, it is hoped, will be of use to the cane-grower and jaggery manufacturer.

(1) Recommended varieties of sugarcane.
(2) Hints on manuring of sugarcane.
(3) Equipment necessary for a large-scale jaggery boiling unit suitable for tracts where cane is grown over large areas.

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[12] The process described here is based on an unpublished note by Dr. B. T. Narayanan, former Joint Director of Agriculture, and Sri. M. Subbiah, Retired Agricultural Chemist, to both of whom my grateful acknowledgements are due.

(4) Special equipment necessary in the preparation of cream jaggery.

Recommended Varieties of Sugarcane

A. Varieties in Cultivation :

1. *H.M.* 320. H.M. 320 is a thick cane, which can be planted over a wide season without adversely affecting quality or yield. It flowers very sparingly or not at all and the green tops provide excellent fodder. It is soft enough to give a good extraction (60-65 per cent.) for making jaggery, but has a hard rind resistant to rodent and jackal attack. Under average conditions it gives an yield of 30-40 tons per acre, and an average recovery of 12 per cent. jaggery or roughly 300-400 md. of jaggery per acre. Under favourable conditions, higher yields are possible, the maximum recorded yield being 100 tons per acre. The quality of jaggery produced is excellent.

2. *Co.* 419. The total area under this cane, including the factory zones, where it is the sole variety cultivated, is about 32,000 acres. It possesses great vigour and gives yields of 35-40 tons per acre. The extraction, though not so good as H.M. 320, is still fairly good, being about 58 per cent. The jaggery is somewhat dark, but possesses good grain and hardness. It ratoons well and 2 ratoons can be taken with profit.

The chief drawback of this variety is that it flowers profusely under Mysore conditions and is therefore not suited for planting during the main season.

This variety is recommended to localities where ratoons are a standard feature of cane cultivation and for planting as an *adsali* (July-October) crop for which it is particularly suited.

H.M. 661. This is one of the seedling canes evolved under the Indian Central Sugarcane Committee Breeding Scheme, at Bangalore, and is noted for its great vigour and rich juice. Its performance has been tested in all parts of the State and it has given high yields everywhere. It yields 40-45 tons and ripens in about 12 months.

It is a medium thick cane which tillers profusely and arrows sparsely. Its fibre content is somewhat high but its extraction is as good as Co. 419. The quality of jaggery is also good.

It ratoons well and comes up well even under poor soil conditions. It is becoming popular in Bangalore and Mysore Districts and occupies at present 300 acres.

H.M. 647. This is another improved cane noted for its erect habit, complete absence of lodging and very sparse flowering. It gives jaggery of an excellent quality. It is a thick cane with a moderate fibre content and ratoons well. It must be harvested early (10-11 months) as it will rapidly go pithy.

H.M. 645. This is a thin or reed cane of the *Cheni* type and has been introduced into cultivation in the *Cheni* area of the State. It tillers profusely and arrows sparsely and ratoons well.

The colour and quality of jaggery from this variety are excellent. It can be recommended with confidence in the areas where *Cheni* type of cane is being grown.

The area under this variety is estimated at about 400 acres mainly in the Chennarayapatna and Krishnarajpet Taluks.

I.C. 26. A thick cane with vigorous habit and and non-flowering or sparsely flowering. It yields 40-45 tons per acre and gives a jaggery of good colour and hardness. It ratoons well.

Other Improved Varieties Ready for Release

In addition to the above, the following high-yielding varieties are ready for release and limited quantities of seed setts can be supplied to interested cane-growers for trial planting on their lands. They are all good jaggery types.

I.C. 136. An early variety ripening in about 10-11 months. Yields 35-40 tons per acre.

Co. 417. A Coimbatore cane, late-maturing (14-15 months). Yields 40-45 tons per acre.

I.C. 203. Similar to Co. 417 in habit and yield, but ripens in about 13 months.

I.C. 225. A medium thick cane, sparsely flowering and early ripening (10-11 months). Yields upto 50 tons and gives jaggery of good quality.

I.C. 215. A thick cane of the Co. 419 type, sparsely flowering and gives yields upto 50 tons per acre. Very vigorous and

non-lodging in habit. Gives a good extraction (60 per cent.), and the jaggery produced is of good quality. It is a late-maturing type, ripening in about 14 months.

Co. 636. One of the recent batch of Coimbatore canes. Gives a good yield (40-45 tons per acre), but rather hard. It can be tried in *Cheni* areas.

Hints on Manuring of Sugarcane

The following manurial formula has been recommended for general guidance.

(1) A green manure crop should be grown *in situ* and incorporated into the soil 2-3 weeks before planting cane. Sunnhemp and cowpea mixtures are suitable for this purpose and a seed rate of 60 lb. per acre gives a luxurious stand for green manure. One cwt. of bonemeal or superphosphate should be applied to the field at the time of sowing the green manure.

(2) At the time of the second ploughing or some other suitable stage of preparatory tillage, at least 10 cartloads of well rotted farmyard manure or compost should be applied.

(3) The following top-dressing of oilcakes and ammonium sulphate should be given to the growing crop.

Light Sandy Soils.—1½ tons of groundnut oilcake or 2-3 tons of castor cake and 7-8 cwt. of ammonium sulphate. Two cwt. of ammonium sulphate should be applied at the time of planting the setts and the rest in 2 or 3 doses along with oilcakes at intervals of about 6 weeks.

Heavy Soils.—½-¾ ton of groundnut oilcake or 1-1½ tons of castor cake in two doses and 5 cwt. of ammonium sulphate (2 cwt. of planting and the rest along with the oilcakes).

Manures are utilised by the crop only in the presence of adequate soil moisture and farmers are advised to irrigate a heavily manured crop adequately.

Equipment Necessary for a Complete Jaggery Boiling Unit to Handle Cane Grown in an Area of about 150 Acres[13]

Cane Mill.—The cane mill should be a power-operated one capable of handling 1¼-1½ tons of cane per hour with an average extraction of 60-65 per cent. of juice. The mill should

[13] Based on an estimate prepared by Sri. S. Venkatasubbaya, B.E., formerly Agricultural Engineer in Mysore.

have fast and loose pullies so that the electric motor may be started with no load and switched on for load. The mill bearings should be of ample size to prevent over-heating when running for 24 hours per day.

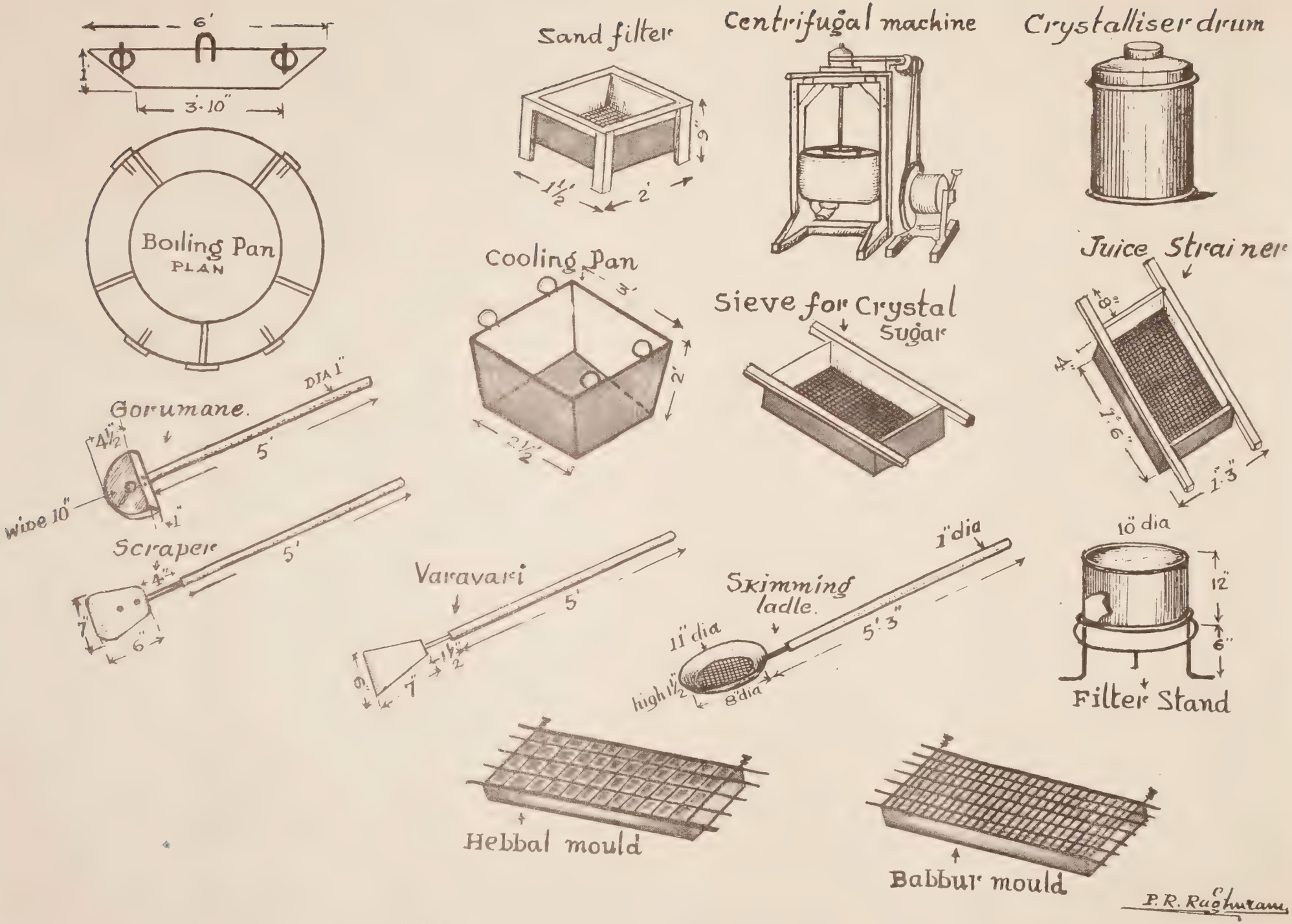
Power Unit.—Where electric power is available, it is better to use electric motor of suitable reserve power with proper safety measures. But in places where electric power is not available, oil engines or diesel oil engines of sufficient capacity may be used. Generally, oil engines now working to run rice mills can conveniently be used as they are generally of 25-35 H.P. capacity.

Furnaces.—The mill will be discharging at an average rate of 40,000-43,000 lb. of juice in each 24 hours which requires at least 10 setts of furnaces going full blast. To provide for contingencies and breakdowns we need at least 12 setts of furnaces to handle this quantity of juice. These furnaces should be of the departmental approved plan, *i.e.*, two pan furnaces to utilise the waste heat of the furnace. It is better to use burnt brick for all the outside construction and mud plastering or cement rough plastering and the furnace portion be built out of fire bricks with fire clay to resist the continuous heat better.

Equipment.—To use the above mill and furnace properly and effectively, we need $24 + 4 = 28$ pans of which 12 may be square pans with pipe connection and a stopcock to stop the fluid and the rest may be of round standard 4′ diameter bottom pans to facilitate easy handling. In addition to these there should be 6 cooling pans of $4' \times 4'$ size. We need at least 15 skimming ladles, for collecting scum and other materials like scrapers, etc. It is better to instal a small pump to pump the juice from the mill to the pans so that there may be savings in labour charges to handle the juice, which can be driven from the mill itself.

Moulds.—It is better to have about 12 moulds each of sufficient capacity to receive one charge.

Staff.—There should be one foreman to be in charge of the whole operation who can handle the mill, the furnaces, etc. In addition to the above, there should be 3 fitters to operate the motor and mill and attend to minor repairs, etc., to be in charge of the shift as the factory will have to work all the 24 hours of the day.



JAGGERY BOILING AND SUGAR MAKING APPLIANCES

Operators.—Each furnace should have the following men to work for 24 hours.

Boilers—2; Firemen—3; Helpers—2.

Thus we have to employ 24 boilers, 36 firemen who can be female labourers and 24 helpers who may be boys of 16 to 20 years in age. Thus, in each shift of 8 hours, there will be the following men available : 8 boilers, 12 feeding labourers and 8 helpers and 12 sets of firemen.

In case the juice pump is not installed, it requires an additional 6 labourers to transport the juice in each shift.

Building.—It is better that the mill portion is separated from the furnace portion, particularly so if there is a juice pump. Otherwise, the motor at least must be enclosed in a locked room with its switchgear and starter so that the inexperienced labourers who work day and night do not have any chance of access into the motor room or go near the belting.

The followiig floor space is required :

One room for motor and switchgear—10′ ×12′. Mill—20′ × 12′.

For 12 furnaces a shed of 20′ span and 156′ length is required or 2 sheds parallel to one another 80′ long may be built, one of them to have an extension of 25′ × 20′ long to accommodate mill and motor and enough space to stock about 10 tons cane.

The roofing must be of fire-proof material such as G.I. sheet or cement asbestos sheeting on stone pillars or rails or masonry pillars.

Special Equipment Necessary in the Preparation of Cream Jaggery

Sand Filter.—For making the sand filter, an old bucket is taken and the bottom removed. A wire frame is fixed in its place and wire-gauze cloth of mesh 80-100 is placed on the wire frame and soldered. The bucket is then supported on a tripod.

River sand is washed thoroughly, dried and sieved, so as to separate fine from coarse sand. The bottom of the bucket filter is filled with coarse sand to a depth of 4″ and then a

similar layer of coarse sand. On top of this, paddy husk char (prepared by charring paddy husk and washing it thoroughly) is spread to a depth of 2". A cloth spread over this completes the filter.

Skimming Ladle.—This is simply an ordinary skimming ladle in which the perforated metal ladle is replaced by a fine wire cloth, supported on a wire frame.

(Received : 3rd February 1955)

Selected Article

AGRICULTURAL RESEARCH, EDUCATION AND EXTENSION IN HOLLAND

[The first agricultural school in Holland was founded in 1876, thirty years before our school at Hebbal was established. The first experiment and research station came into being in 1877, only 27 years before the Hebbal Farm was started. The first extension staff—they were called agricultural teachers after the *Wanderlehrer* (itinerant teacher) in Germany, were appointed in 1890, twenty-four years before our agricultural inspectorate was organised. Dutch agriculture was, therefore, not more than three decades ahead of us. But the progress made by them in the last 7 to 8 decades in agricultural research, education and extension are indeed very remarkable for a country with only 61·8 lakh acres of cultivated land—less than two-thirds of the cultivated area in Mysore and with a population almost nearly equal to ours.

With a total of only about 230,000 farmers and growers there are now 50,000 pupils attending classes in agriculture of one kind or another. In Mysore there are hardly 400 pupils in agricultural schools and colleges for 63·43 lakhs engaged in agriculture.

Besides the world famous Royal Tropical Institute—Tropical Products Department at Amsterdam, there are hosts of institutes for agricultural research, some of the most important being the Government Experimental and Research Station at Hoorn, the Institute of Modern Livestock Nutrition at Hoogland, the Institution for the Improvement of Crops and the Institute of Agricultural Research, both at Wageningen, the Agricultural Experimental Station and Institute of Soil Research at Groningen, Laboratory of Soil and Crop Testing at Oosterbeck, Soil Survey Institute at Bennekom, Institute of Agricultural Engineering and Rationalisation, Institute for Horticultural Engineering both at Wageningen, Institute for Storage and Processing of Horticultural Produce, Institution of Potato Storage, Institute of Plant Breeding and Crop Improvement,

Institute for Research on Varieties of Field Crops, Institute of Phytopathological Research. Besides these, there are research institutes for specifc crops and purposes like the Laboratory of Bulb Research, Flax Institute, Institute of Dairy Research, Institute of Rational Sugar Production, Research Station for Straw Processing, for Potato Processing, Institute of Poultry Farming, State Veterinary Research Institute, etc. Against this imposing array of institutes, we have in Mysore, besides the main laboratories only 10 stations and farms to conduct agricultural research.

As regards agricultural eytension, there is one District Assistant Adviser for every 400 to 500 farmers in Holland (1 Agricultural Inspector for every 70,000 farmers in Mysore).

In Holland, agricultural research, education and extension are closely linked together and largely financed by the State to the tune of about 30 million guilders per annum or approximately Rs. 3·75 crores, representing about 1% of the value of the aggregate agricultural output of the country. About 20% of the funds for agricultural research are contributed by private bodies.

The following articles extracted from the *Agricultural Newsletter from Netherlands* for February and March 1956, on research and education in Holland will prove interesting to our readers.—*Ed.*]

Wageningen, Centre of Agricultural Science

WAGENINGEN is the centre of agricultural research in the Netherlands. It is the seat of the Agricultural University with its many laboratories and divisions. It is also the seat of various autonomous research institutes.

In general it can be said that the University is both a training centre and an institution for the cultivation of fundamental research. The autonomous institutes perform research work more in the field of applied science, since the problems tackled by them are generally closely connected with the practical side of agriculture. Many of the institutes are governmental, others are semi-official, a few are run under the auspices of industries.

Of late, research problems are being tackled thoroughly. Many new laboratories have been founded, some are in the course of construction and others have been planned.

Agricultural Research

The following is a survey of the laboratories and institutes built at Wageningen since 1918.

Divisions of the Agricultural University

1922 Laboratory of Plant Physiological Research.
1922 Microbiological Laboratory.
1923 Horticultural Laboratory.
1923 Laboratory of Phytopathology.
1925 Institute of Plant Breeding.
1925 Division of Agricultural Machinery and Buildings.
1925 Laboratory of Animal Husbandry.
1929 Laboratory of Genetics.
1932 Laboratory of Agricultural Chemistry (destroyed during the war).
1933 Institute of Forestry.
1934 Laboratory of Botany.
1935 Auditorium.
1935 State Agricultural Library.
1939 Laboratory of Tropical Agriculture.
1941 Laboratory of Dairying.
1948 Division of General and Agricultural Economics.
1953 Laboratory of Surveying.
1953 Laboratory of Field Crop Husbandry.
1954 Laboratory of Animal Physiology.
1954 Technological Laboratory.
1956 Laboratory of Agricultural Chemistry.

Autonomous Institutes

1947 Forest Research Station T.N.O.
1949 Research Laboratory for Agricultural Chemistry Research and Advisory Office of the Netherlands Superphosphate Industry.
1949 General Netherlands Inspection Service for Seeds of Field Crops and for Seed Potatoes (N.A.K.) (Extension).
1950 Institute for Phytopathological Research.
1951 Drying Research Laboratory, Section of the Central Institute of Agricultural Research.

1951 Experiment Farm of the Institute for Research on Varieties of Field Crops.
1951 Plant Protection Service (Extension).
1952 Institute for Research on Storage and Processing of Horticultural Produce.
1952 Agricultural Office for Basic Slag.
1952 Experiment Station of Milling and Baking (Extension).
1952 Foundation for Agricultural Plant Breeding.
1952 Foundation for the Improvement of Forest Seeds and Plants.
1953 Cereals Department of the Central Institute for Nutrition Research T.N.O.
1953 Institute of Horticultural Plant Breeding.
1953 Dutch Flax Institute.
1953 Institute for Potato Storage.
1954 Institute of Agricultural Engineering and Rationalization.
1954 Institute of Horticultural Engineering.
1954 Institute for Research on Varieties of Field Crops.
1954 Government Seed Testing Station (Extension).
1955 Experiment Station "De Bouwing" of the Central Institute of Agricultural Research.
1955 Plant Nutrition, Research Laboratory of the Chilisaltpetre Agricultural Service.
1956 Two laboratories for the Institute for Biological and Chemical Research in Agriculture, by abbreviation of the Dutch name : I.B.C.-O.L.

Most of the older laboratories have been modernised since 1948. In the 40 divisions of the Agricultural University and the 30 autonomous institutes there are 600 research workers and 1,550 other persons, all living at Wageningen (21,000 inhabitants). The experimental fields of the laboratories and institutes at Wageningen cover a total area of 775 acres. Some of the Institutes also have an outside service (*e.g.*, the Phytopathological Service, the Institute for Phytopathological Research, the Foundation for Agricultural Plant Breeding, the N.A.K., the Soil Survey Institute, the Laboratory of Agricultural Engineering, etc.). The Laboratory of Bulb Research (Lisse) and the Biological Station (Wijster) are situated outside Wageningen ; both institutes are divisions of the Agricultural University.

Agricultural Education

The Agricultural University is the source of the agricultural Schools in the Netherlands. A great number of teachers received their training at Wageningen. At this moment there are in the Netherlands 4 Higher Agricultural Schools, 3 Secondary Horticultural Schools, 1 Secondary School for Tropical Agriculture, 1 for Silviculture and Land Improvement, 2 for Dairying, and moreover 43 Agricultural, and 10 Horticultural Winter Schools (1 specializing in Floriculture).

The Agricultural University is also the source of staff for:

Ministry of Agriculture, Fisheries and Food.
Agricultural University.
Autonomous Institutes at Wageningen.
Research Institutes outside Wageningen.
Agricultural and Horticultural Schools.
Agricultural Advisory Service (Agriculture, Horticulture, Soil Utilization and Reallotment, Tenancy, Dairying, Livestock-Breeding, Poultry-Breeding and Bee-Keeping).
Food Supply.
Forest Service.
Fisheries.
Government Service for Land and Water Use.
Netherlands Land Development and Soil Reclamation Society (Ned. Heide Maatschappij).
"Grontmij" Ltd. Land Improvement and Reclamation Company.
Reclamation Project of the Zuiderzee.
Agricultural and Horticultural Organizations.
Dairy Co-operations.
Seed Inspection Services.
Private Plant Breeding Stations.
Agricultural Industries (Dairying, Brewing, Strawboard Manufacturing, Timber and Paper Industry, Canning, Oil Factories).
Trade (Fertilizers, Agricultural Machinery, Seeds, Disease-Control Products, Fodder).

Further, some 300 Graduates of Wageningen are working in foreign countries at:

Private Estates in Tropical and Sub-Tropical countries.
Research Stations.
Forest Services.

International Organizations.

Foreign Agrarian Information Services.

Since the foundation of the Agricultural University in 1918, more than 2,200 students have completed their studies.

Agricultural Extension

The Agricultural Advisory Service in the Netherlands is for the greater part decentralised, but 13 advisory officers in general service (specialists, *e.g.*, for seed production, grassland, farm-building, agricultural implements, etc.) live at Wageningen. Most advisory officers, however, are in charge of a district. They received their training at Wageningen. They are the mediators between science and practice. Many young graduates work in the advisory service under the guidance of the advisory officers.

In general it can be said that every year ½% of the gross value of the total production in agriculture is spent on the rationalization of agriculture in the Netherlands and the increase of its production.

The activities of agricultural societies is moreover of great importance.

Wageningen, A Transmitting Station

Farmers and gardeners know how to tackle the problems with which they are faced ; they are skilled workers. Without them Wageningen would be little more than a centre of science ; thanks to their powers of reception it is an important transmitting station. Large numbers are correspondent in the evaluation of varieties and many professors and directors are presidents, members or advisory members of agricultural boards.

International Exchange of Information

It is to be welcomed that the Government and the trade stimulate the organization of congresses, symposia or technical meetings and enable scientific workers to visit them, also when they are held abroad.

Meetings and other forms of international co-operation have considerably increased of late. In Wageningen 12 international congresses were held last year.

Since 1952, Wageningen has had an International Study Centre. It is the centre where annual summer courses are held on methods of agricultural instruction. Each year this course is attended by some 100 advisory officers from foreign countries.

Periodicals, the Editorial Boards of which are also located at Wageningen are : *Euphytica,* Netherlands Journal of Plant Breeding ; *Mededelingen van de Landbouwhogeschool* (Reports of the Agricultural University), *Netherlands Journal of Agricultural Science* and the *Tijdschrift over Plantenziekten* (Journal of Plant Diseases).—*Agricultural News Letter,* February 1956.

The Training of the Dutch Graduate Agriculturist

In the Netherlands there is only one training centre which produces graduates in agriculture: the Agricultural University at Wageningen.

The education provided at this establishment was raised to University standard in 1918; and since then Graduates of Wageningen have been awarded the Academic Degree of "landbouwkundig ingenieur" (Graduate Agriculturist). In principle anyone is eligible to study at the Agricultural University, but before he can sit for the examinations and obtain the certificates the student must be in possession of a Netherlands Secondary School Leaving Certificate. The Leaving Certificate of one of the four Agricultural Secondary Schools in the Netherlands also gives the holder these rights. Equivalent certificates of other countries likewise entitle the holder to enter for the examinations.

The majority of students commence their studies between the ages of 18 and 20, so that their University training follows immediately after their Secondary Education. Some of them take advantage of the opportunity, whereby those who are 25 years of age or older may, under certain circumstances, be allowed by the Ministry of Agriculture to sit for the examination without being in possession of the certificates otherwise required.

The course lasts 5 years or more. The first 16 months (propædeutic study) are spent in acquiring a general grounding in a wide range of subjects—botany, mathematics, chemistry, physics, meteorology, economics, hydraulics, mineralogy, petrology and geology, mechanics, and general agronomy. It is only after this that the various branches of study diverge. There are 14 branches, covering agriculture, tropical agriculture, horticulture, forestry, tropical forestry and rural home economics.

During his two years of study for the Bachelor's Degree, the student must take a number of compulsory subjects, the purpose of which system is to give him a wide agricultural education in the branch or sub-branch he has chosen.

If he wishes, the student may supplement this syllabus with other subjects chosen from those taught at the Agricultural

University, although according to some the number of compulsory subjects is already too large.

When the student has obtained the "Candidaat Landbouwkundig Ingenieur" Diploma [approximately equivalent to B.Sc. (Agr.)] at the end of the two-year period previously referred to, he spends six months doing practical work. This may be interrupted, if necessary. The time is spent partly on farms or in market gardens, partly in agricultural industries, in nurseries, in the agricultural advisory service or, in exceptional cases, in the laboratories of research institutions. The students are encouraged to spend part of this practical period abroad. Indeed, in the case of tropical studies a visit to southern countries is almost essential.

The final phase of the course consists of 1 to 1½ years devoted to a more specialized and independent study of from 4 to 6 subjects. The student is then usually expected to study or work out a particular problem in each of these subjects; this may take the form of practical work or a theoretical treatise based on the relevant literature. For most subjects the results of this study must be set out in a written paper. The Diploma is awarded after a final examination in each subject.

Higher agricultural education is conducted on University lines. Theoretical training is the primary consideration and is given priority over the imparting of practical skill, although the latter is certainly not neglected. Furthermore, emphasis is laid on broad-based training rather than on a high degree of specialization. In the course of time there has been a great deal of discussion of the aims and objects of higher agricultural education in the Netherlands, but there is a fair consensus of opinion that the direction followed is the right one.

If strong emphasis were to be placed on practical knowledge and ability, the training would lose its University character and sink to the level of Secondary Education.

It is precisely because of the all-round training they receive that there is such a wide choice of situations open to Graduates of Wageningen.

Moreover, in research work particularly, there is also a demand for a large number of specialists. A commission recently gave its opinion on the question of how higher agricultural education could best meet these requirements. It recommended

that the factual knowledge required for a particular post, and the necessary specialization, should be catered for by a period of post-graduate instruction after completion of the University course proper. In the past the graduate received this post-graduate training while actually working in his job, but under the new system this would be done more systematically and efficiently in the environment of the Agricultural University.

The training for research specialist might be further improved by encouraging the student to prepare a thesis for obtaining the Degree of Doctor of Agriculture, by increasing the opportunities of becoming assistant to a Professor, and by awarding scholarships to enable graduate agriculturists to work in research institutes in other countries.—*Agricultural News Letter*, March 1956.

Growth of Sesbania

Correspondence

A NOTE ON THE GROWING OF *SESBANIA SPECIOSA* (GREEN MANURE PLANT) IN BANGALORE DISTRICT

We first read of this green manure plant nearly 5 years ago when its extensive cultivation was strongly recommended by the Madras Agricultural Department after the excellent results obtained by them at Aduthorai Research Farm. It was reported that seedlings from 4 oz. of *Sesbania* seeds when planted on the bunds of one acre of paddy fields would provide adequate green manure for that acreage. It was also stated that 50 lb. of *Sesbania* seeds grown on paddy after the harvest would produce about a lakh lb. of plants that would give green manure for 10 acres of land.

Some *Sesbania* seeds obtained from Aduthorai were sown in our home garden and also at our farm in Abigere village, Yeswantpur Hobli. The growth of the plants was however not impressive. The plants were stunted in growth and did not yield plentiful leaves. The seedlings planted along the borders of paddy fields also did not thrive. Judged from what was reported to have been achieved in Tanjore and neighbouring places, the results were disappointing. We were however advised by Dr. B. Sanjeeva Rao (Retired Professor of Chemistry and Principal of Central College) that the plants probably required a selective bacterial organism in the soil in sufficient proportion before they could thrive. We were also told by Dr. S. V. Govindarajan (Agricultural Chemist, Government of Mysore), that he had actually seen *Sesbania speciosa* growing very well in Tanjore delta where he saw the crop sown on paddy fields growing to a height of 12′ and above. We however learnt from him that the soil there is clayey whereas the experiments conducted by us were on red soil.

Bearing in mind what Dr. B. S. Rao and Dr. Govindarajan said, we persevered in cultivating *Sesbania* and in February 1955 we obtained seeds from Messrs. A. Karuppan Nadar, Sivakasi, and sown on 1/3 of an acre. The seed rate used was 120 lb. per acre though the recommended rate by the Madras Agricultural Department was 50 lb. One difficulty experienced with

Sesbania seed was its poor germination. It was said that to aid germination the seed could be pounded mixed with sand or could be steeped in hot water at 70° for 10 minutes. We had however sown the seeds without any pre-treatment. Incidentally, it will help agriculturists if the Agricultural Department could carry out tests and recommend the best procedure for pre-treatment of the seeds as well as for preparing the soil for sowing to suit conditions in Mysore State.

The seeds were sown by us on 15th March 1955, after the field was well ploughed. Superphosphate at the rate of 1 cwt. per acre was ploughed into the soil. The soil was clayey loam and was sufficiently moist. The plot was the same on which *Sesbania* was grown as a marginal crop the previous year though without much success as already reported. The germination of seed was slow and the initial growth of the seedlings did not appear to hold out much promise. A portion of the field received a heavy irrigation but this, far from improving the growth actually retarded it. The plants turned yellowish and took time to revive. With *mungari* rains and occasional judicious irrigation the plants once established rapidly grew and on July 14th, exactly 4 months later, they reached a height of 7-8′ (as seen in the photograph). The leaves were succulent and the stalk was not at all woody. Excepting the marginal plants the rest did not freely flower.

One interesting point was that cattle and even goats did not feed on the plants whereas sunnhemp grown on the adjacent plot was avidly eaten. *Gliricidia maculata* was also found to be eaten by goats and by some cattle which probably had cultivated a taste for it. The farm workers say that cattle did not touch *Sesbania* even during the seedling stage. Unlike sunnhemp the plants were not adversely affected by any pest. Considering all the above points *Sesbania* appears to be an excellent green manure crop as in addition to the heavy yield of green manure it is free from pest and is not eaten by animals. The plants were cut on August 17th and had by then grown to a height of 9-10′. The green manure was sufficient for 2½ acres of paddy field.

From our short experience it appears to us that the growth of *Sesbania* is an attractive proposition. Its extensive growth for green manure purposes, even when irrigation facilities are moderate should receive every encouragement. This note is written in the hope that the cultivation of *Sesbania* will receive

serious consideration at the hands of the agriculturists in Mysore State.

This year again we have grown *Sesbania* on the same plot of ground on ½ acre. The seeds were kindly made available by Dr. B. Dasappa, Deputy Director of Agriculture, from Nagenahalli Research Station. As advised by the Agricultural Department, the seeds were steeped in water for 30 hours, the water used being changed once after 15 hours. The germination of the seed was satisfactory. The seed rate used was 100 lb. per acre.

The seeds were sown on 14th March and in about 6 weeks the plants have grown to the height of 8-20".

Our thanks are due to Dr. B. Sanjeeva Rao and Dr. S. V. Govindarajan and Dr. B. Dasappa for their helpful suggestions.

B. KRISHNAKANT.
B. GANAPATH RAO.

Bangalore,
May 10, 1956.

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PLANT PROTECTION

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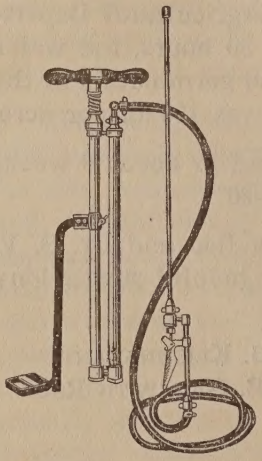
FOR PLANTATIONS & FARMS



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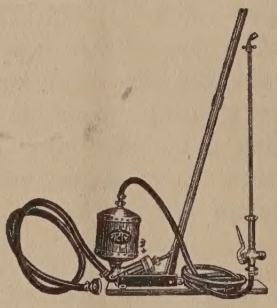

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